

Radio, Electronics and Communications

FORMERLY "RADIO & ELECTRICAL REVIEW" — WIDELY KNOWN SINCE 1946 AS "R. & E."



In This Issue . . .

Low power 432 megacycle transmitter.
On the definition of aerial gain.
What is a spectrum analyser?—conclusion.
Field interlace system for closed circuit television.
"Electronics in Action"—provisional list of papers.

PUBLISHED MONTHLY IN THE
INTERESTS OF THE N.Z. ELEC-
TRONICS INDUSTRY FOR ALL
LEVELS, FROM PROFESSIONAL TO
AMATEUR.

VOLUME 21
MAY 1,

NUMBER 3
1966

PRICE 2/6



**AWA
DEVELOPS
NEW
SEARCH
AND
RESCUE
PACKSET**



ENQUIRY CARD AD. 1



Water lily and valve... beauty in pure lines and beauty in pure sound. One designed by Nature, and the other by Brimar for true-to-life reproduction and consistent reliability.

better rely on -



N.Z. Distributors:-

Standard Telephones and Cables (Pty.) Limited AN **ITT**
ASSOCIATE

Auckland, Box 571; Upper Hutt, Box 140;

Now, sweep oscillators with interchangeable

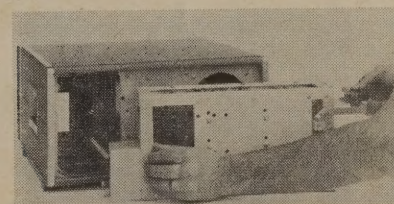
New Hewlett-Packard 8690-Series "Convertible" Sweep Oscillators provide all the convenience of "plug-in" construction while retaining the performance and operating features of conventional single-band units. A single main frame, Model 8690A, accepts rf units for all frequency bands from 1 GHz to 40 GHz.

Two product design innovations contribute to the high performance of these new sweepers. First, the rf units or modules are inserted from the rear. Second, novel "snap-in" calibration dials may be interchanged in only a few seconds. Dials are full instrument width for high resolution, and are keyed, to eliminate the need for recalibration or adjustment when inserted.

Three sweep functions, start-stop, marker sweep, and delta-F, are selected by pushbuttons. Manual or externally triggered sweeps may also be selected by front-panel controls.

The HP Model 8690A is priced at £852/10/-. The most commonly used rf units are priced as follows: 8691A (1 — 2 GHz), £1045. 8692A (2 — 4 GHz), £935. 8693A (4 — 8 GHz), £866/5/-. 8694A (8 — 12.4 GHz), £866/5/-. 8695A (12.4 — 18 GHz), £935. 8696A (18 — 26.5 GHz), £1375. 8697A (26.5 — 40 GHz), £2365. PIN-modulated 8691B (1 — 2 GHz), £1210. 8692B (2 — 4 GHz), £1100. 8693B (4 — 8 GHz), £1045, and 8694B (8-12.4 GHz), £1058/15/-. Current delivery estimates on the 8690A and rf units are 12-14 weeks. Prices shown are duty paid, delivered anywhere in New Zealand.

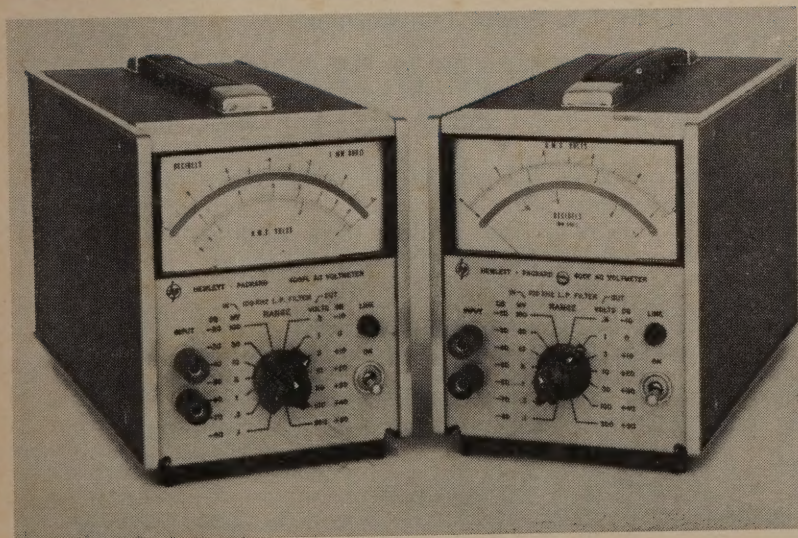
RF Units!



**Change
scale
when you
change
plug-ins**

New h.p. AC Voltmeters

higher sensitivity, high input impedance



The newest of the well-known Hewlett-Packard 400-Series AC Voltmeters, 400F and 400 FL, have 100 μ V full-scale ranges, and 10 megohm input impedance. An ac output produces one volt rms for full-scale meter deflection, regardless of range and use; on the 100 microvolt range, the amplifier has 80 dB gain with less than 5 μ V noise. Frequency range of the new instrument is 20 Hz to 4 MHz. Accuracy, in the range from 100 Hz to 1 MHz, is $\pm 0.5\%$ of full-scale $\pm 0.5\%$ of reading for the 400F, and 1% of reading for the 400FL. Model 400F presents a linear voltage scale uppermost, while Model 400FL presents a linear dB scale uppermost.

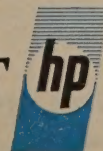
The extraordinary gain of the built-in amplifier, and the high sensitivity which is characteristic of the instrument, make it especially useful as a calibrated high-gain preamplifier for oscilloscopes, bridge detectors, and other devices. In acoustical measurements, sensitivity is sufficient that a calibrated microphone may be connected directly to the input terminals. Prices: Model 400F, £151/5/-. Model 400FL, £156/15/-. Duty paid. Delivery time—4 weeks.



**SAMPLE
ELECTRONICS (N.Z.) LTD.**

8 Matipo St., Onehunga, Auckland, S.E.S., Phone: 567-356

HEWLETT



PACKARD

An extra measure of quality

SERVICE AND CALIBRATION FACILITIES PROVIDED. SPARE PARTS ALWAYS AVAILABLE

ENQUIRY CARD AD. 2



SILICON DIODE POWER TRANSFORMERS AVAILABLE FROM BEACON RADIO LTD.

R98 T.V. POWER TRANSFORMER

For R.T.V. & H. 1959 and later T.V. Sets.
Delivers 260v @ 300mA D.C. Full wave voltage doubler.

230:115v A.C. @ 300mA D.C.

:12.6v C.T. @ 5A (2 windings ea. 6.3 @ 5A).

:0—6.3—7.5—9 @ .6A. Picture tube winding.

Choke:—C36. Use 400v P.I.V. Diodes.

R103 Stereo Power Transformer

R.T.V. & H. Aug. 60. 7w Stereo.

230:245v @ 150mA D.C.

:104v @ 150mA D.C. Voltage doubler Rect.

:6.3v C.T. @ 5A.

Choke:—C42. Use 400v P.I.V. Diodes.

R104 Stereo Power Transformer. 10w

320v @ 320mA. Voltage doubler Rect.

230:130v @ 320mA.

:6.3v @ 6A.

Choke:—C49. Use 500v P.I.V. Diodes.

R105 T.V. Power Transformer For Philips T.V. Kits

220v @ 420mA D.C. Voltage Doubler Rect.

230:106v @ 420mA D.C.

:6.3v @ 10A.

:0—6.3—7.5—9 Ov @ 0.3A. Picture tube Winding.

Choke:—C45. Use 400v P.I.V. Diodes.

R106 T.V. Power Transformer for Philips T.V. Kits

This type similar to R105 but less Picture Tube boost taps. Main Fils. 12.6v C.T. @ 5A.
220v @ 420mA D.C. Voltage Doubler Rect.

230:106v @ 420mA D.C.

:12.6v C.T. @ 5A (2 windings 6.30v @ 5A each).

:6.3v @ .3A Picture tube winding.

Choke:—C45. Use 400v P.I.V. Diodes.

R108 Small Stereo Headphone Power Transformer

250v @ 22mA D.C.

230:110v @ 22mA D.C. Voltage doubler Rect.

:6.3 @ 0.86A.

Choke:—C41. Use 400v P.I.V. Diodes.

R110 T.V. Power Transformer. For Philips T.V. Kits

This transformer uses full wave bridge rectifier. Requires no limiting resistor unlike equivalent voltage double types, also has advantage of no insulated capacitor and lower ripple output with smaller choke.

Output 220v @ 420mA D.C.

230:172v @ 420mA D.C. Full wave bridge Rect.

:12.6v C.T. @ 5A (2 only 6.3v winding @ 5A).

:6.3v @ .3A Picture tube winding.

Choke:—C50. Use 400v P.I.V. Diodes.

R111 T.V. Power Transformer

Similar to R110 but for R.C.A. type Kits.

260v @ 350mA from Rect.

230:207v @ 350mA D.C. Full wave bridge Rect.

:12.6v C.T. @ 5A (2 only 6.3v windings each 5A).

:6.3v @ 0.6A. Picture tube winding.

Choke:—C42. Use 400v P.I.V. Diodes.

R112 Oscilloscope Power Transformer

R.T.V. & H. 1963. Calibrated.

230:110v @ 80mA D.C. Full wave voltage doubler.

:6.3v @ 2.4A.

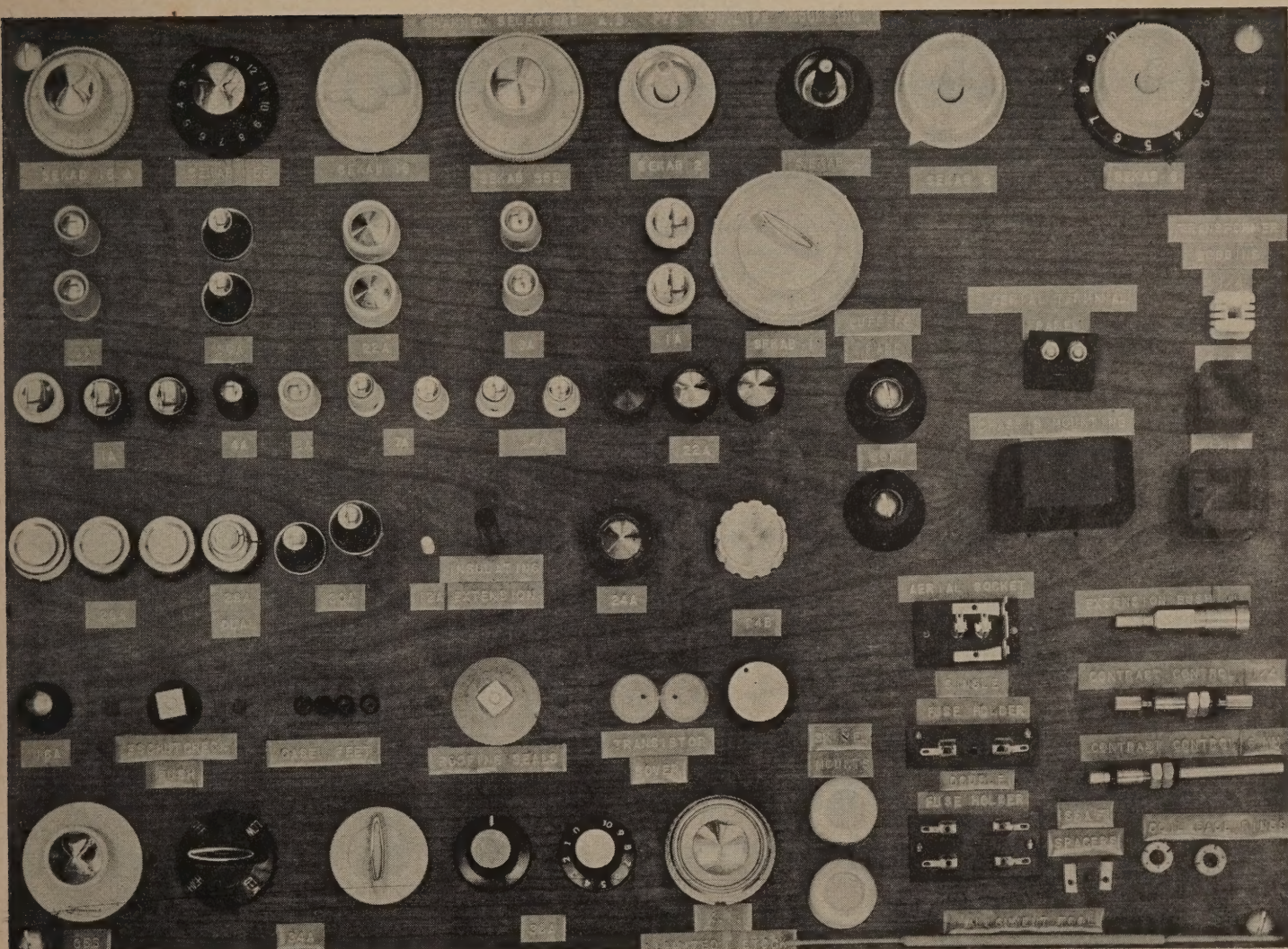
:6.3v @ 1A.

:6.3v @ 1A.

Use 400v P.I.V. Diodes.

BEACON RADIO LIMITED

Corner Brown and Fitzroy Sts., Ponsonby, Auckland. P.O. Box 2757. Telephone 12-168 (5 lines)



We stock a wide range of SEKAB KNOBS

This specialist range of industrial components includes

- **ALIGNMENT TOOLS**
- **CHANNEL SELECTORS**
- **CONTROL KNOBS**
- **Fuseholders**
- **Aerial Sockets**
- **Transformer Bobbins**

The illustration shows some of the quality injection moulding available



DISTRIBUTED BY:

P. H. ROTHSCCHILD & CO. LTD.

P.O. BOX 30-170 LOWER HUTT

83 PRETORIA STREET

TELEGRAMS "FRANDS"

ENQUIRY CARD AD. 5

See all measurements — down to the last microvolt!

with high resolution Sanborn thermal writing oscillograph

**HEWLETT
PACKARD
SANBORN
DIVISION**

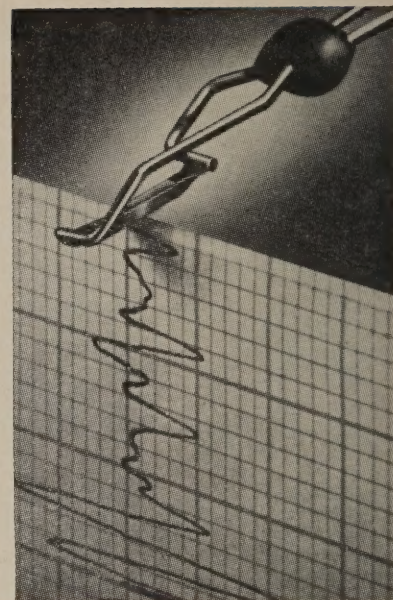
Resolve and read the smallest variations in your test parameters — even at higher frequencies, small amplitudes, and at slow chart speeds. Sanborn heated stylus oscillographic recording on matching Permapaper charts gives you an immediate, permanent and clear record of test variables. . . . lets you make "straight across" comparisons and correlations of multiple channels quickly and accurately because of rectangular co-ordinate traces . . . lets you clearly see what happened — as it is happening, and at any future time for more study or proof of performance.

The wide range of signal conditioners includes low-cost built-in units, all-channels-alike amplifiers in six or eight-channel modules, and two series of individual channel plug-in units — miniaturized solid-state signal conditioners and highly sophisticated, maximum performance units. Check the brief specifications of the systems shown below or call Sample Electronics for complete technical data and application engineering assistance.

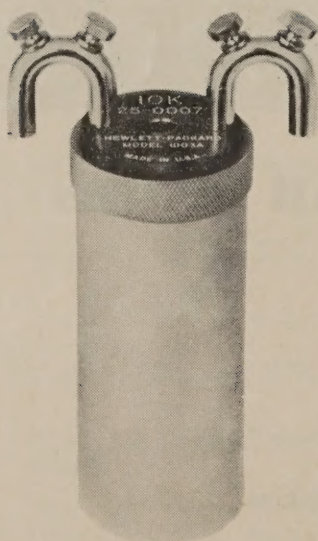
SINGLE-CHANNEL SPECIFICATIONS:

Economical "briefcase-size" recorders. Model 7701A 100mm chart. Frequency range DC to 3GHz. Linearity 0.5%. Sensitivity (depending on "8800" Preamp used $1\mu\text{V}/\text{div}$ to $5\text{ V}/\text{div}$. Four chart speeds, 4 more optional. With case: £728/15/- plus preamp. Models 299, 301 — 862 mm chart. Frequency range DC to 100 Hz. Linearity 0.625%. Sensitivity $10\text{ mV}/\text{div}$ (Model 299), $10\text{ uV rms}/\text{div}$ (Model 301). 2 chart speeds. Model 299, £440. Model 301, £467/10/-.

Also available are 2, 4, 6 and 8 channel models.



New Standard Resistors adjustable exactly to desired value



New standard resistors from Hewlett-Packard are adjustable within a range of ± 25 parts per million, for the first time making it possible to achieve calibration exactly at the nominal value of the primary resistance standard. The new Hewlett-Packard standard resistors' specified accuracy better than 6 parts per million, or 0.0006% uncertainty) is almost 2:1 improvement that of previous standard practice. Their drift rate, typically 3 parts per million per year, is somewhat under half that which was previously available.

Adjustability, with precision of 0.15 PPM, eliminates the inconvenience of dealing with odd fractional-value resistance standards, speeds calculations. In standards labs and calibration facilities, the new HP resistors can reduce the number of steps per operation and cut the chances of calculating errors.

The Hewlett-Packard advance in standard resistor accuracy and stability was achieved by using new materials and new construction methods, within entirely traditional con-

figurations. Long-term drift, it has been shown, is largely caused by the gradual relaxation of wire stresses; temperature coefficient is also affected by winding technique. Winds in the new HP resistors are held without tension between two concentric cylinders of polyester film. The sandwich thus formed is supported securely at both ends, and oil is allowed to flow freely throughout. Choice of wire and new winding methods further contribute to the new resistors' characteristic low drift, both short and long term. Low temperature coefficient has reduced the effects of self-heating; the time required for thermal equilibrium is similarly reduced.

Hewlett-Packard Standard Resistors are offered in values of $100\ \Omega$ (Model 11102A), $10,000\ \Omega$ (Model 11104A), and $100,000\ \Omega$ (Model 11105A). Price, each, is £41/5/0. Current delivery estimates are 12 - 16 weeks.

Duty paid. Other ohmic values to complete a complimentary range are about to be released.



**SAMPLE
ELECTRONICS (N.Z.) LTD.**

8 Matipo St., Onehunga, Auck., S.E.S., Phone: 567-356

HEWLETT  PACKARD

An extra measure of quality

SERVICE AND CALIBRATION FACILITIES PROVIDED. SPARE PARTS ALWAYS AVAILABLE



Radio, Electronics and Communications

Formerly Radio and Electrical Review
(Established 1946)

CONSULTANT EDITORS:

C. W. Salmon, M.N.Z.I.E.,
Grad. I.E.E., Assoc. I.E.R.E.
I. H. Spackman, A.M.I.E.E.E.
P. L. Watts
representing
N.Z. Electronics
Institute

EXECUTIVE EDITOR:

Robin H. E. Beckett.

* * *

Published Monthly by the
Proprietors:

THE MAGAZINE PRESS LTD.,
Publishers also of
HOME AND BUILDING

at the Registered office of the
company, Employers Association
Building, 157 Khyber Pass,
Auckland, C.3, N.Z. P.O. Box
1365, Auckland. Telephone 41-
508, 41-519.

Director and Chairman:

Victor L. Beckett
A.A.I.(Aust.) Hon.A.N.Z.I.A.

Director and Secretary:

Wilma W. Beckett

Production Manager:

Robin H. E. Beckett, B.A.

OFFICIAL JOURNAL OF

**The New Zealand Electronics
Institute (Inc.)**

Secretary: **J. L. McKie,**
P.O. Box 1506, Christchurch.

* * *

Sole New Zealand Distributors:

**GORDON & GOTCH (N.Z.)
LTD.**

From Newsagents — 2/6 per
copy. Or direct from the pub-
lishers 30/- per year in ad-
vance, post free throughout the
world.

* * *

Advertising Representatives for
the United Kingdom.

**PUBLISHING & DISTRIBUTING
CO., LTD.,**

177 Regent St., London, W.1.

* * *

Printed by Farrell Printing
Ltd., Mt. Roskill, Auckland.
Registered as a newspaper at
the G.P.O., Wellington.

Volume 21, Number 3

May 1st, 1966

CONTENTS



	Page
Editorial	9
A low power 432 megacycle trans- mitter	11
<i>by Irving Spackman, ZLIMO</i>	
On the definition of aerial gain	14
<i>by M. F. Radford</i>	
What is a spectrum analyser?	16
—conclusion	
<i>by Russ Myer</i>	
Circuit & Service Data—DRECO	19
Field Interlace System for Closed Circuit Television	24
<i>by A. B. E. Ellis</i>	
"Electronics in Action"—National Electronics Conference	30
National Electronics Research Council—objects and membership	33



Departments . . .

Letters	7
Serviceman's Column	23
<i>Conducted by J. Whitley Stokes</i>	
Book Reviews	35
New Products	37

Coming . . .

Looking at Magnetic Heads
10 Meg. Instrument Amplifier
432 Meg. transmitter—Part II
TV Kitset
Electronics in Action—latest news
V.L.F. Research—Part III

On Our Cover



The New Zealand Search and Rescue organisation has awarded a contract to Amalgamated Wireless (Australasia) N.Z. Limited to manufacture 138 lightweight radiotelephones. The equipment chosen—AWA Packset TR3—was designed by AWA's New Zealand engineers to meet the requirements of the SAR organisation. The TR3 is fully transistorised, runs on dry torch batteries and, complete with accessories, weighs only 7½ lbs. Although SAR sets are single channel, a two channel model for the export market and other New Zealand applications has been developed and is in production.

Interest in this miniature 2 channel H.F. radio-telephone, which is capable of communicating over long distances, has been expressed by authorities in Australia and Malaysia. AWA is building up a creditable list of successes in the export field. This year the Company obtained the largest single overseas order (valued at £A10,000) for Marine communication equipment ever received by a New Zealand manufacturer.

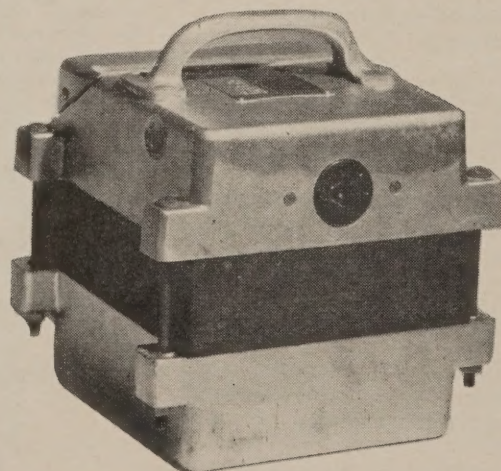
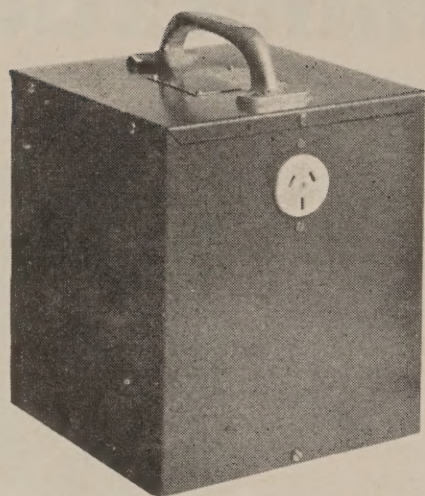
ENQUIRY CARD AD. 6



Also . . .

Circuit & Service Data
Listening Post
Serviceman's Column
New Products
Book Reviews

ENQUIRY CARD AD. 7



2 Styles of Isolation trans- formers

Just two of the many from ATC's stable, these soundly designed units feature the sturdy, practical, dependable day-in day-out performance that have made ATC the top name in transformer equipment. Used with complete confidence by builders, factories, garages and the home constructor.

Available for permanent wiring applications and can also be fitted with circuit breakers, magnetic or thermal type.

Double outlets or special Reyrolle plugs and sockets to customer specification. Full range of ratings from 25 watts to 5 kilowatts either 230 volt or 400 volt input.

We will gladly advise and quote for non-standard and special applications "tailor-made" to your specifications.

• Write for our comprehensive catalogue.

AUCKLAND TRANSFORMER CO LTD.

20 EDEN STREET, NEWMARKET, AUCKLAND

PHONES 51-307, 549-280, 544-126

TELEGRAMS "TRANSFORMA"



Letters from Readers

Sir,

As I am interested in the stereo amplifier system which you described in your 1965 September issue is it possible to get back numbers. Our station copy has been mislaid and thus all the necessary information is missing.

Or, is it possible to get just the information on the amplifier without purchasing the whole September issue.

Congratulations on a fine magazine.

D.P.W., 4ZA
Invercargill

Further to your recent letter we have forwarded you September issue and also March, 1966 issue, which included some further notes.

(Please see note below concerning the remaining information on the stereo equipment).

—Ed.

I am writing in respect to an article in the 1965 September issue. In this issue was printed the circuit for a transistor Stereo Amplifier and Pre-amp.

I am very interested in building this amplifier, and would very much appreciate the copy of the veroboard design and a more detailed layout of both amplifier and pre-amp. Knowing that the suggested layout has been proved I would prefer to use this layout as accurately as possible.

M.W.K. Wellington

Further to your recent letter we hope to be able to provide you with copy of the veroboard design and more detailed layout of amplifier and pre-amplifier in the very near future.

Our efforts to finalise the stereo system have unfortunately been handicapped by the non-availability of components from the N.Z. agents. We are informed that a further supply of these components is at present coming to hand after being held up in customs for some time. Once these have arrived we shall very shortly be able to provide you with the information you require and publish final information on the system.

—Ed.

ENQUIRY CARD AD. 23



ENQUIRY CARD AD. 22

COASTAL RADIO

representing in New Zealand the following international manufacturers.

Raytheon Company — U.S.A.
Raytheon Canada Limited — CANADA.
Cossor Communications Co. Limited — U.K.
Cossor Electronics Limited — U.K. (Marine Division).
Dansk Radio Aktieselskab — DENMARK.
Staveley Smith Controls Limited — U.K.
Terma Electronics Limited A/S — DENMARK.
Associated Aerials Limited — U.K.
Coastal Radio Limited — U.K.
Stoner Electronics Inc. — U.S.A.
Teletron Limited — IRELAND.
Measurements Engineering Limited — CANADA.

N.Z. Representative:



Coastal Radio (N.Z.) Limited

G.P.O. BOX 269
TELEPHONE 35-699

2 TARADALE ROAD

NAPIER






TELEGRAMS "COASTALRAD"

**Producers
of all types of
communication
radar and
navigation
equipment.**

SILICON-CONTROLLED RECTIFIERS

from **AWA**

*These RCA types cover
your most important current
requirements*

	I RMS	100 PRV (REP)	200 PRV (REP)	400 PRV (REP)	600 PRV (REP)
	35 A	2N3896	2N3897	2N3898	2N3899
	12.5 A	2N3668	2N3669	2N3670	2N4103
	7 A		40378	40379	
	5 A		2N3228	2N3525	2N4101
	2 A		2N3528	2N3529	2N4102

Whether your design has application in stepless control, in mass-produced line-operated appliances, or in commercial and industrial power control, relaying, or other switching functions, RCA SCR's offer the extra design features for operation at full name-plate rating. Available only from AWA.

AMALGAMATED WIRELESS (AUSTRALASIA) NZ LTD.



2nd Floor, Commerce House, Wakefield Street. P.O. Box 830, Wellington. Tel. 43-191

P.O. Box 1363
AUCKLAND
Tel. 10-129

P.O. Box 2084
CHRISTCHURCH
Tel. 62-158

P.O. Box 932
PALMERSTON NORTH
Tel. 83-671

P.O. Box 1026
DUNEDIN
Tel. 88-058

P.O. Box 1055
WHANGAREI
Tel. 82-189

P.O. Box 467
INVERCARGILL
Tel. 89-777



Music and Measurements

A recent article in an American journal discussing desirable room sizes for stereophonic reproduction prompts us to consider this question as applied to the average New Zealand home. The article, in "Audio", April 1966, confirms that at least eight feet separation is needed between stereo speakers and that the ratio of 1 to 1.4 is needed in the room width/length measurement. To avoid obvious deficiencies due to placing speakers too near to the side walls this means that the room should be some 12 feet wide and 17 feet or 18 feet long. Unless one's purse is longer than that, the living room of a small New Zealand home (in the £4000 to £6000 bracket) is likely to be shorter by several feet, although the chances are that the width will be 12 feet to accommodate broadloom carpet without cutting loss. Even if the 18 feet desirable is attained it is quite on the cards that this length will be achieved by including the dining alcove (complete with sliding doors!)

Even if these desirables are found the chances of good high fidelity listening are almost certain to be spoiled by the wall and ceiling materials of the room, as these are likely to be of solid plaster board types which have no acoustic absorption. Acoustic ceiling tiles are a help, but, to be frank, do not always add to the attractiveness of a living room.

One, then, is prompted to ask whether stereo is really worthwhile in the small home. On the basis of ideals in room sizes it would seem that the effects obtained could be far from true "faithful sound" let alone high fidelity. What, therefore, is the solution?

Should the intending user be intent on stereophonic reproduction in a small living room then care should be taken to ensure that the best possible acoustic conditions prevail. Where cost, layout and aesthetic or decorative con-

siderations allow, soft drapes should be used to cover hard vertical surfaces — especially glass doors or large window areas facing directly opposite the speakers. Bear in mind the directional characteristics of the speakers and that there will be an area somewhere particularly, in the room where best coverage is obtained. Listening is best done towards this part of the room but this may pose problems in placing chairs near fireplaces or radiators for personal comfort.

If the original article reaffirmed our hesitations over stereo in the average home, then let us hasten to say that at least it has confirmed our opinion that single cabinet stereo units are largely gimmicks. For this reason, at least, it is pleasing to see that several local manufacturers are now producing stereo players with separate speakers at a not unreasonable price.

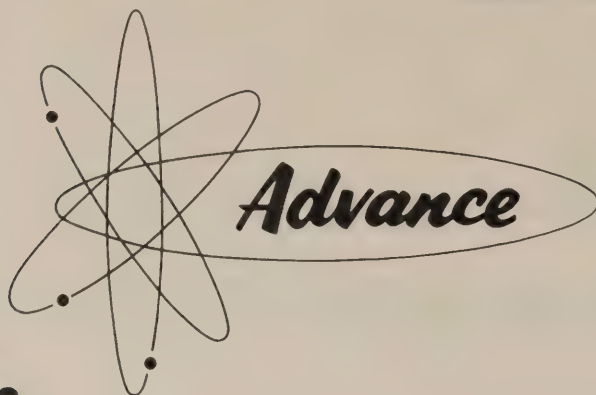
For all this, we are not yet convinced that good quality monaural is done for. In fact, after listening to stereo outfits in many situations it is still a pleasure to go home and listen to the eight year old valve type monaural amplifier plus 10 inch Goodmans.

Which is the point of these words. It is felt there is definite merit in providing good monaural reproduction in a small living room rather than poor stereophonic sound that is possibly provided by a quite expensive set of equipment. Realising by now that the hounds will be out already could we raise the scent by suggesting that there are only some recordings that truly show stereo sound to real advantage under home conditions.

Who knows, perhaps monaural will become the in-thing for 1967.

C.W.S.

ENQUIRY CARD AD. 10



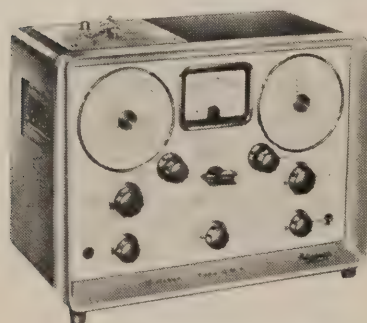
V.I.F. function generator & Q meters

SG88

V.L.F. Function Generator

Frequency range 0.005c/s to 50c/s for single cycle disc. Higher frequency is possible by use of 2, 3 or 4, etc., cycle disc. Calibration $\pm 1\%$ full scale. Output VOLTAGE Continuously variable from 200 μ V to 22V pk.pk. AMPLITUDE VARIATION Within 1dB over entire frequency range. IMPEDANCE At maximum output 6k Ω , mid setting 16k Ω , depending on frequency. WAVEFORMS Any single valued repetitive function. Facilities Direction of rotation of the waveform disc can be reversed, thus reversing the time

sequence of the waveform. Automatic frequency sweep device on the 0.5 to 5c/s and 5 to 50c/s bands. Sweep time is approximately 2 minutes for any 10:1 frequency excursion. Four waveform discs (sine, square, sawtooth and white noise) and one blank disc supplied. Special discs made to order. Power requirements 105 to 125V, 190 to 250V, 50 to 60c/s, 165W. Dimensions 19 $\frac{1}{2}$ in (50cm) wide \times 13in (33cm) high \times 15in (38cm) deep. Weight 80lb (36kg).



CM1

'Q' Meter

'Q' range 15 to 600 in two bands. Oscillator frequency 100kc/s to 100Mc/s in six bands. Frequency accuracy $\pm 1\%$. Stabilised signal level. Main capacitors Capacitor scales 10 to 70pF (± 1 pF), 40 to 600pF ($\pm 2\%$). Reactance (Xf) scales 16000 to 2200 Ω -Mc/s; 4000 to 300 Ω -Mc/s. Inductance (Lf²) scales 2500 to 350 μ H-Mc/s²; 600 to 50 μ H-Mc/s². Incremental capacitor ± 5 pF (on 40 to 600pF range of main capacitor) in divisions of 0.2pF. Accuracy of inductance measurement $\pm (5\% + \text{residual inductance of } 0.035\mu\text{H})$. 'Q' range 15 to 150, 60 to 600. Accuracy $\pm (5\% + 5\% \text{ F.S.D.})$ below 50Mc/s. For frequencies above 50Mc/s and 'Q' readings above 400 the tolerance should be doubled. '% Q' scale Range $\pm 10\%$ (relative to nominal 'Q' reading). Power requirements 105 to 125V, 195 to 225V, 225 to 260V, 50c/s (models to suit other frequencies can be supplied). Dimensions 18in (46cm) wide \times 14in (35.5cm) high \times 9 $\frac{1}{2}$ in (24cm) deep. Weight 38lb (17kg).

T2

'Q' Meter

'Q' range 10 to 400 in two bands. Accuracy $\pm (5\% + 5\% \text{ F.S.D.})$ below 50Mc/s. Oscillator frequency 100kc/s to 100Mc/s in six bands. Accuracy $\pm 1\%$. Main capacitors Capacitor scale 40 to 550pF ($\pm 2\%$). Reactance (Xf) scale 4000 to 300 Ω -Mc/s ($\pm 2\%$). Inductance (Lf²) scale 600 to 50 μ H-Mc/s² ($\pm 2\%$). Incremental capacitor 2.5pF. Accuracy of inductance measurement $\pm (5\% + \text{residual inductance of } 0.03\mu\text{H})$. '% Q' scale Range 10% (relative to normal 'Q' reading). Accuracy $\pm 1\%$ (i.e. ± 1 division up to 50Mc/s). Power requirements *110 to 120V, 200 to 210V, 220 to 230V, 240 to 250V, 40 to 60c/s, 20W. Dimensions 15 $\frac{1}{2}$ in (39cm) wide \times 10 $\frac{1}{2}$ in (26cm) high \times 6 $\frac{1}{2}$ in (16.5cm) deep.

Weight 14lb (6.5kg).

*Special model available T2E 110 to 125V, 130 to 140V, 160V, 220V, 40 to 60c/s.

ADVANCE ELECTRONICS LIMITED ENGLAND

Sole New Zealand Representatives

TURNBULL & JONES LTD.

Auckland

Wellington

Christchurch

Dunedin

FROM THE COMPREHENSIVE RANGE OF



INSTRUMENTS AND EQUIPMENT

with a line through the mounting holes at right angles to this centre line.

The 144 mhz input socket is $\frac{3}{8}$ inch from left hand edge of chassis. The tripler socket is 1 inch from the input socket with the anode tuning capacity centred a further 1 inch from the valve socket. The grid tuning capacitor for the amplifier is spaced 2 inches from the tripler anode capacity whilst the amplifier socket is a further 2 inches from the grid capacitor. The amplifier anode circuit tuning capacitor is $3\frac{3}{8}$ inches from the amplifier socket hard against the right hand end of the chassis.

The output coupling socket is located centrally between the amplifier socket and anode tuning condenser, off-set to one side of the centre-line by $\frac{5}{8}$ th inch, with the reactance cancelling trimmer as close to the side of the socket as possible, mounted by the same screw as supports one side of the socket. All other components except the coils are not particularly critical in location, with the photos giving sufficient information in this respect.

A shield of thin brass or tinplate is mounted across the full width of the chassis, dividing the amplifier socket on the grid-pen side of the central spigot. One point to remember — use only P.T.F.E. or ceramic sockets, without metal skirts for best performance.

1000 pf. feedthrough capacitors

are used for TP1, 2 and 3. TP3 is the output voltmeter test point. This voltmeter consists of two 3.3 K ohm $\frac{1}{4}$ watt carbon resistors mounted with short leads from the coaxial output connection to ground. Across the earthed resistor is connected a germanium diode such as an OA85, with the other end of the diode connected to the feed-through capacity, which also forms the test point.

Unbypassed resistors are used in the screen leads of both the tripler and amplifier to discourage parasitic oscillations.

The tuning capacitors used in the tripler anode and amplifier grid circuit were Johnson miniature shaft mounting butterfly types, whilst the final amplifier tuning capacitor is a Jackson model. This latter type was very suitable for this position because it can be mounted on two studs from the chassis with the rotor shaft isolated from earth (see photos). If a capacitor with shaft mounting is used, it will be necessary to mount a block of plastic across a 1 inch hole in the chassis; then mounting the capacitor through a suitable hole in this plastic. The values of tuning capacitors used were:—

Tripler anode capacitor, 8 pf. per section (Johnson 160-208 or equivalent).

Amplifier grid circuit, 11pf per section (Johnson 160-211 or equivalent).

Amplifier anode circuit, 5 pf per section (Jackson or equivalent).

Coil Data

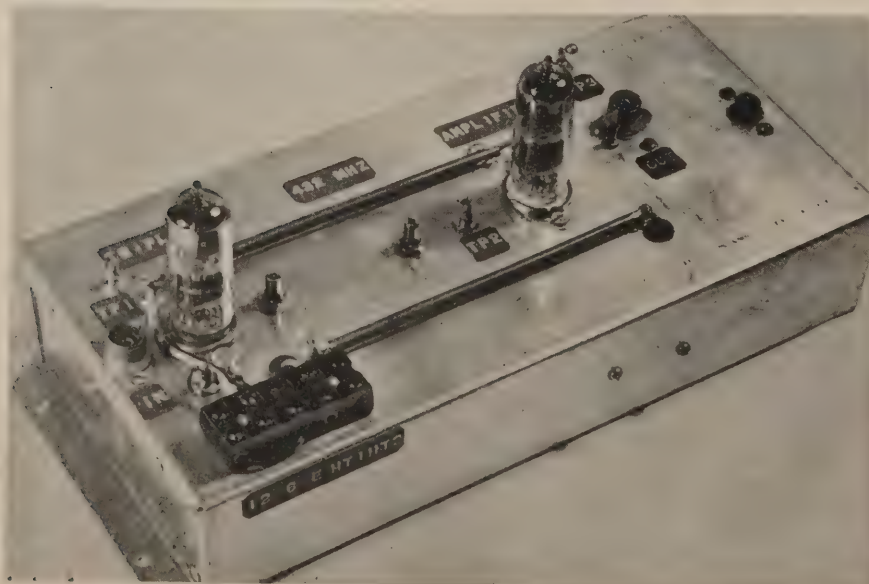
The input circuit to the tripler is self resonant with the input capacity of the tube. As there is generally adequate drive available from the 144 mhz source in most cases, the tuning of this circuit is not particularly critical, and adjustment by spreading or compressing turns is usually sufficient (see adjustment later).

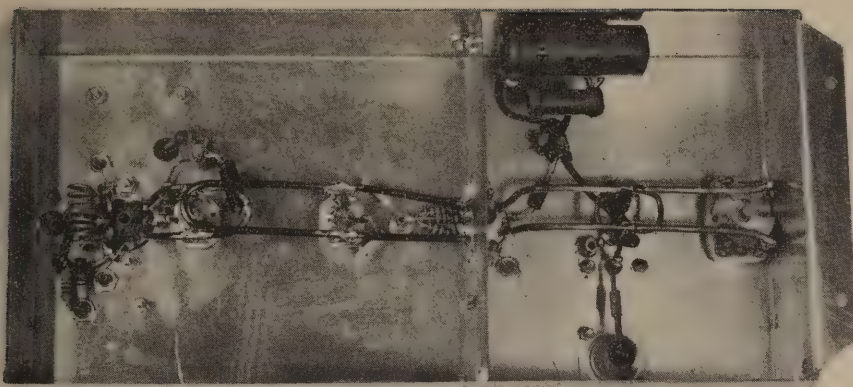
- L1 1 Turn around centre of L2.
- L2 9 Turns $\frac{1}{4}$ inch diameter spaced to $\frac{3}{8}$ inch mounted directly on grid pins of socket.
- L3 Loop 14G. enamelled copper $1\frac{7}{8}$ th inches long $\frac{1}{2}$ inch wide. The loop is bent at angle to meet socket pins, from a point 1 inch from closed end. Fix coil to tuning capacitor at $\frac{3}{8}$ inch from closed end, at ends of stator rods.
- L4 Loop 14G. enamelled copper 4 inches long $\frac{1}{2}$ inch wide bent at angle to meet socket pins from a point $2\frac{3}{8}$ inches from closed end. Tuning capacitor centre is 2 inches from closed end. Space L4 about 1/16th inch below L3.
- L5 2 lengths of 14G. copper wire preferably silver plated or tinned, $4\frac{1}{8}$ inches long. Bend ends to attach to tuning condenser so lines are $\frac{1}{2}$ inch apart centre to centre. Bend down at $\frac{5}{8}$ th inch from tube end to meet socket pins putting lines 1 inch below chassis.
- L6 Loop of 18G. wire covered with spaghetti. $\frac{3}{4}$ long, $\frac{1}{2}$ inch wide. Each end of loop extended out $\frac{3}{8}$ th inch and bent down to connect to capacitor or output connector.

The series capacitor connected to L6 is a 4 pf. maximum ceramic pillar trimmer.

Here are a few other details of construction. The chassis should be equipped with a flat aluminium bottom plate. This reduces radiation from the lines and increases the power output slightly. Don't forget however to retune all circuits after installing the plate.

The two thin copper tubes fixed on the surface of the chassis serve only to hold filament and H.T. wiring neatly to the chassis and shield them as they pass across the top. In any event, do not take them through the inside of the chassis





as this could cause undesirable feedback.

The filaments of the two tubes are so wired that they can be connected in series for 12 volt use, or in parallel for 6 volt operation. All filament lines are fed through 1000 pf. feedthrough capacitors to the top of the chassis.

The resistor and bypass capacitor shown in the photograph is purely to reduce the supply voltage of 200 to 180 volts, for the final amplifier tube plate and screen. This means that a common 200 volt supply can

be used for all the equipment. Do not use more than 180 volts to the final stage if it is to be plate and screen modulated. If C.W. or F.M. service is intended then 200 volts can be used on the final stage. In either case 200 volts can be applied to the tripler.

Adjustment of the unit

Firstly connect a suitable source of 144 mhz energy to the input socket. Approximately 3 watts is adequate. If less than this is available it may be necessary to resonate L2 more carefully. If excess drive

is available then the coupling between L1 and L2 may need to be reduced.

Apply filament power (the filament should be set for 6 or 12 volts as required), and once these are hot, then 144 mhz drive can be switched on and the various circuits adjusted to get 3mA of grid current flowing in the tripler, as measured at TP1. Now, with a high voltage source of no more than 200 volts connected to the tripler (HT1) apply drive and high voltage together and adjust C1 and C2 alternately for maximum grid current to the amplifier measured at TP2. At least 2mA and preferably more should be flowing after all circuits are correctly adjusted. If necessary, re-adjust tripler input circuit to maintain 3mA of drive to this stage.

Now remove drive and H.T. (CAUTION) and connect the H.T. to the final amplifier as well (HT2) connect a dummy load or the antenna feedline and apply drive and all high voltages again. Quickly resonate the final tuning condenser as indicated by voltage present at TP3. Alternate adjustment of the loading capacitor, the final tuning condenser, plus possibly the output link should yield maximum R.F. output power.

Before operation check the input to the final stage is 10 watts or less for plate modulated voice. For this service the supply to HT2 should be run through the secondary of a suitable modulation transformer.

An allied equipment, on which the information demanded by the clerk could be shown, is an electronic data display. Basically a standard monitor such as is used in closed circuit TV, the display has a screen divided into 64 lines, each containing 64 squares each made up of 64 dots. Television raster techniques are used to generate characters on the screen and the shape to be traced is defined by a word in binary code.

Parallel mixed inputs from TV cameras can be applied to the data display to provide accurate registration of maps, charts, graphs and symbols, say Plessey, the makers. Both the touch wire system and the data display are shortly to go into production.

Man and Computer May Converse

A concerted attack on the problem of easing communication between man and computer is being made on a number of fronts by one of Britain's largest electronics organisations. The attack is being made because the computer is gaining wider and wider acceptance as a business and industrial control tool, and the shortage of staff qualified to instruct the machine is becoming acute.

A number of developments have been announced, all aimed at enabling a computer to be addressed directly without the intervention of experts.

One device shortly to enter production is an advanced unit for character recognition, based on original work carried out at Britain's National Physical Laboratory. Intended to enable the computer to read ordinary paperwork directly, without introducing highly stylised characters, the device's applications could include cheque, money order and bond reading and sorting, and the identification of documents and accounts.

Because stylised characters are not called for, document preparation becomes simpler, say the firm. The machine scans each character electronically and presents an electronic analogue to recognition circuits which look for a certain com-

bination of recognition features — 20 in each of the 0-9 numerals — in order to identify the character.

The possibility of talking directly to a computer over a telephone link is held out by a voice recognition system which uses a simple filter network to change speech into digital form. At present, the device can only cope with numbers, but, say its developers, it foreshadows an age when man and computer engage each other in conversation.

An untrained operator can interrogate a computer using a touch-wire system consisting of a number of wires embedded in the glass face of a television monitor screen. The wires are arranged to give a keyboard with a virtually infinite number of contacts. Touching the appropriate point on the system releases corresponding information from the computer which is presented in the correct sequence.

... on the Definition of Aerial Gain

by M. F. Radford*

There are several recognised ways in which the performance characteristics of aerials may be expressed, and some are more flattering than others. For example, a voltage standing wave ratio of 0.5 sounds better than the equivalent power standing wave ratio of 4:1, and directional radiation patterns look more attractive plotted in relative power than in decibels. However, the greatest opportunity for confusing the reader is in the expression of aerial gain.

What is meant by gain? Power gain is defined by Terman¹ as 'the ratio of the power input to a comparison antenna required to develop a particular field strength in the direction of maximum radiation to the power input that must be delivered to the directional antenna to obtain the same field strength in the same direction'. Kraus² defines the power gain, G , as

$$G = \frac{\text{max. radiation intensity from a reference antenna with the same power input}}{\text{max. radiation intensity}}$$

It will be seen that these definitions are for all practical purposes equivalent. The next step is to choose a reference aerial.

The usual standard, preferred by the I.E.E. and most other authorities, is the lossless isotropic source. This is a perfectly efficient, linearly polarised radiator in free space which gives the same radiation intensity in very direction. It is most convenient for theoretical work, but has the unfortunate disadvantage that it cannot exist in practice. It can be demonstrated mathematically that such an aerial would have boundary conditions contrary to the fundamental equations of electromagnetic theory. This can be shown more readily by a topological analogy.

Consider a small spherical animal entirely covered with fur, which it

brushes in an attempt to make it lie flat all over. It is not possible to find a method of brushing the fur that does not leave a tuft, crown, parting or vertex somewhere. Let the orientation of the fur represent the polarisation of the radiation of a source at the centre of the sphere, and the argument is proved.

Alternative reference aerials which can be used experimentally are the half-wave dipole, the short vertical radiator, and the quarter-wave monopole. The last two are suitable for use only in conjunction with a ground plane. If perfectly lossless, relative gains with respect to an isotropic source are as follows:

Element	Power gain relative to isotropic source
$\lambda/2$ dipole	1.64 times or 2.15dB
Short vertical	3.00 times or 4.76dB
$\lambda/4$ monopole	3.28 times or 5.15dB

Here, gains are expressed as simple power ratios and also in decibels. Voltage ratios are rarely used. Decibels are generally preferred as they are more convenient to use in system calculations.

Now, the power gain discussed above is the measure of the ability of an aerial to produce a field at a distant point for a given input power, and it is therefore of vital importance in transmitting. For reception in the h.f. band, where

the level of interference rather than receiver threshold noise sets the limit of sensitivity the ability of the aerial to discriminate between different directions of arrival is of greater importance. This is properly called directivity or directive gain, and is defined by Terman¹ as 'the ratio of power that must be radiated by the comparison antenna to develop a particular field strength in the direction of maximum radiation to the power that must be radiated by the directional antenna to obtain the same field strength in the same direction'. This differs from the earlier definition in that it considers power radiated rather than power input. Directivity, D , is related to power gain, G , by the formula

$$G = kD$$

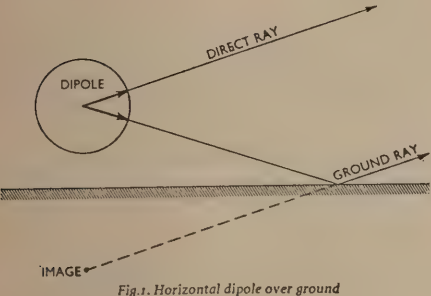
where k is the efficiency of the aerial. Efficiency includes the effect of heat losses in the aerial, in the ground and in matching devices integral with the aerial, and also losses due to power radiated in sidelobes. Aerials with terminating resistors, heavy ground currents and high sidelobes thus have low efficiencies.

Directivity has the advantage of being directly calculable from complete radiation patterns. Either the maximum radiation intensity may be compared with the total radiated power integrated over a sphere, or an approximate formula may be used. Kraus² gives the rule:

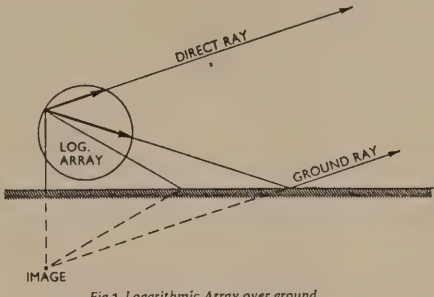
* The Marconi Company Ltd., Chelmsford, England.

41253
D = $\frac{41253}{B_E B_H}$

where B_E and B_H are half-power beamwidths in the E and H planes respectively, and the constant 41253 is the number of square degrees on the surface of a sphere. This formula takes no account of beam shape or sidelobe power, and yields a result which is usually about 1 dB too high. However, it is very useful for comparing aerials of the same class, since the differential error is then small.



source in free space from 2.15 to 8.15 dB (Fig. 1). If an aerial having a narrow vertical beam is mounted in the same way, the direct and reflected rays, which leave the aerial at different elevation angles, cannot both lie at the angle of maximum radiation and so the increase of gain due to the ground is less than the full 6 dB.



An interesting paradox thus arises. Suppose a logarithmic aerial with a free space directivity of, say, 9.5 dB over isotropic, or 7.5 dB over a dipole in free space, is mounted over perfect ground at a tilt angle of 30° (Fig. 2). The ground increases its directive gain to about 13.5 dB over an isotropic source and increases the directive gain of a comparison dipole to about 8 dB over isotropic. The directive gain of the logarithmic aerial is thus only 5.5 dB relative to a dipole at the same effective

height over ground, although it was 7.5 dB when both aerials were in free space.

It will be seen that by permuting the above variations an alarmingly large number of gain definitions are possible. Not all are in current use, fortunately, but those that are may differ by as much as 9 dB. Table 1 lists some of the ways in which the gain of a typical new design of logarithmic aerial³, the broad dipole array, may be expressed, the figures being rounded off where appropriate.

Present practice is for gain to be expressed in whichever terms are most convenient for the purpose in hand. System engineers use power gains with respect to isotropic as these are convenient for calculations of field strength or effective radiated power. Aerial designers prefer directive gains over isotropic because they are more readily deduced from model experiments. Salesmen also sometimes quote directive rather than power gains, possibly because they are slightly greater. Field engineers traditionally use power gains with respect to a dipole at the same effective height. Satellite engineers naturally prefer gains in free space.

It is not possible, nor even desirable, to force the use of one preferred definition, since the relative values of the various gains vary according to site, construction, and design elevation angle. However, it is suggested that the lossless isotropic source (always assumed to be in free space) should be used as a reference standard unless there is a good reason for an alternative, and that it is clearly stated whether the gain is power or directive, in free space, or over perfect or average ground. At least engineers will then understand each other.

Table 1
WAYS OF EXPRESSING THE GAIN OF A BROAD DIPOLE ARRAY

Condition	Reference	Power gain, G, or directive gain, D (dB)
Free space	Isotropic	D = 9.5
Inclined over ground	Isotropic	D = 13.5
Inclined over ground (Kraus's formula)	Isotropic	D = 14.25
Free space	Dipole, free space	D = 7.5
Inclined over ground	Dipole, same effective height	D = 5.5
Inclined, perfect ground	Isotropic	G = 13
Inclined, average ground	Isotropic	G = 12
Inclined, perfect ground	Dipole, same effective height, perfect ground	G = 5
Inclined, average ground	Dipole, same effective height, average ground	G = 5
Inclined, perfect ground	Short vertical, perfect ground	G = 8.25*

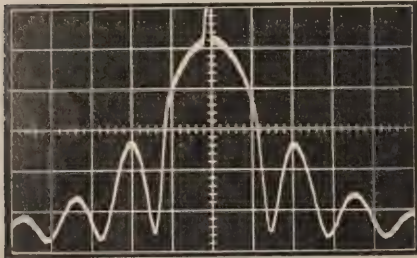
* This last line on the table is included for the sake of completeness, but the short vertical is not a convenient reference aerial for horizontal h.f. arrays, and its use should be avoided where possible.

References

1 F. E. Terman: *Electronic and Radio Engineering* (McGraw-Hill, 1955).
2 J. D. Kraus: *Antennas* (McGraw-Hill, 1950).
3 M. F. Radford and E. W. Woloszczuk: 'New H.F. Logarithmic Aerials', I.E.E. Convention on H.F. Communications, March 1963.

Conclusion

What is a Spectrum Analyser?



Typical Spectral Display

To express a difference in voltage levels, more commonly used in oscilloscope work, the number of bels used as exponents, is divided by 2. Example: a voltage gain of 44 db gives an exponent of $10^{4.4}$. Dividing the exponent by 2 gives a new number: $10^{2.2}$. This is $10^2 \times 10^{.2}$, or 100×1.6 , or 160. Increasing any voltage level (RMS) by a factor of 160 produces an increase in power of about 25,000 times. This is proved by the relationship $E^2/R(160^2)$.

The power formula, $P = E^2/R$ indicates that power increases as the square of the voltage (resistance remaining the same, of course). The oscilloscope is a voltage-operated device; therefore, increasing a vertical signal by a factor of 2 requires a signal 4 times the power of the original.

So much for decibels. Let us return now to the detector circuit and its third or square-law output.

To expand vertical signals, the analyser's detector is operated in the square-law mode. In this manner, the output voltage is the square of the input voltage. Doubling the input causes the output to increase four times. Tripling the input causes the output to increase nine-fold.

The advantage of this circuit can easily be seen. Input signals of nearly the same amplitude are expanded and can be measured more accurately on the crt. Also, the crt now measures relative input power. Doubling the input power doubles the vertical deflection. Thus, the

by Russ Myer*

square-law mode causes the output to behave exactly the opposite of the logarithmic mode.

THE VIDEO AMPLIFIER

The detector circuit is followed by the video amplifier. Signals are fed into the amplifier and applied, push-pull, to the crt vertical-deflection plates. To increase the versatility of the spectrum analyser, video signals can be fed directly into the amplifier, by-passing the i.f. and detector portions of the instrument. This allows an oscilloscope display of ordinary time-based signals.

IMAGES AND OTHER SPURIOUS SIGNALS

Until now, we have assumed that only the signals appearing in the area of the centre frequency are presented on the crt display. Unfortunately, this is not always the case. Other signals also sneak through the analyser and are displayed.

Assume the tuning dial has been set at 300 Mc to observe a signal of that frequency on the crt. Since 300 Mc is the centre frequency signal, it will appear at the centre graticule line. Assume further that along with the 300-Mc input, another signal with a frequency of 700 Mc is present at the input.

Since the first L.O. operates 200 Mc higher than the desired input signal, it will be oscillating at 500 Mc. This frequency beats with the 300-Mc input to produce the 200-Mc difference which is allowed to pass through the 1st i.f.

But . . . the difference between the 500-Mc L.O. and the 700-Mc input is also 200 Mc! So, it too is introduced into the 1st i.f. and, as expected, appears on the crt — exactly super-imposed on the 300-Mc signal at the centre graticule line. Setting the dial slightly to either side of the 300-Mc centre frequency causes the signals to move from the centre graticule area. However, each signal goes in

the opposite direction! A little arithmetic will prove why.

Moving the L.O. to 530 Mc, for example, (tuning dial reading 330 Mc, of course) produces a beat of 230 Mc for the desired input signal of 300 Mc. As the output of the 2nd i.f. is swept through its range of 170 Mc to 230 Mc, it's obvious that the true signal now will appear on the extreme right of the crt. The L.O. frequency of 530 Mc also beats with the 700-Mc input and produces a difference frequency, or beat frequency, of 170 Mc. This causes it to appear to the extreme left of the crt.

This illustrates an important rule: Tuning the L.O. (main tuning dial) to a higher frequency causes the true signal to move to the right of the crt; unwanted signals move to the left. These undesired responses are called "images," or "spurious" responses.

As signals above and below the centre frequency of the 1st L.O. can produce beat frequencies, either of the two could be called the "true" signal, depending upon how the tuning dial is labelled. Signals below the frequency of the L.O. are called true responses and all signals above it, the image signals. The i.f., of course, doesn't know the difference.

Another type of spurious response that shows up on the crt is caused by input signals that fall within the bandpass of the first i.f. Any input signal falling within the range of 170 Mc to 230 Mc will be displayed. This is called i.f. feed-through. This type of spurious signal is the easiest to identify. Moving the tuning dial either direction does not shift the display on the crt. This is because the 1st L.O. does not beat with any input signal to produce the response.

Figure 5 shows two unknown signals on the crt of the scope. Note their positions on the graticule. The dispersion is set at 50 Mc. Thus, each graticule line represents 5 Mc. First attending to signal A, it is moved to the centre graticule line. This will determine the centre frequency of the signal as read on the tuning dial. Assume that it was necessary to tune the dial higher in frequency. The signal moved higher in frequency, also (towards the left). This identifies signal A as a spurious, or image, response

* Tektronix, Inc.

Reading the tuning dial gives a figure of 205 Mc. It is known that the L.O. is operating 200 Mc above the tuning-dial reading, so it must be oscillating at 405 Mc. The image, therefore, is 200 Mc above that, or 605 Mc!

Signal B was moved to the right (down in frequency) to be located at the centre graticule line. The tuning dial would now read 215 Mc, which is the frequency of the true input signal.

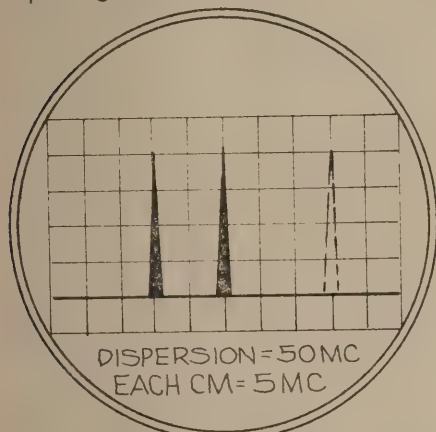


Figure 5. Display after shifting image to center of graticule. This illustrates how two signals, separated by 390 Mc, show up only 10 Mc apart on the crt.

HARMONIC SPURII

When the operation of the Spectrum Analyser is considered, remember that any complex waveform is the algebraic sum of a number of pure sine waves. The analyser permits the display of these individual sine waves on an oscilloscope. The horizontal sweep represents some continuous frequency range.

Any sine wave passed through a non-linear device, such as a tube or a transistor will be accompanied in the output by a new set of frequencies called harmonics. These frequencies will be exact multiples of the original, but of decreasing amplitude. The second harmonic, for example, of a 200-Mc signal, is 400 Mc; the 3rd, 600 Mc, etc.

Here is where much trouble is created with our typical spectrum analyser. Originally, all the signals present at the output of the first mixer were mentioned: the original L.O. frequency, the original input signal, the sum of the two, and the difference, which was the one selected for i.f. amplification. It was learned that any signal 170-Mc to 230-Mc higher than the L.O. frequency would also produce a beat

that fell within the bandpass of the first i.f. And, finally, there was i.f. feedthrough.

But, unfortunately, there are other spuri which can show up on the crt screen.

The mixer will produce harmonics of its two input signals, (original signal and L.O.) which are present in the output. Harmonics of the L.O. are of particular interest to us now. For example, assume the L.O. could be set at 300 Mc to show a 100-Mc input signal on the crt. The second harmonic of the L.O. is 600 Mc. If there were a 400-Mc signal of equal strength at the input of the analyser, it, too, would produce a 200-Mc difference and be displayed on the crt! Because of the decreased amplitude of the harmonic, however, the crt presentation would be less than that of a true-response presentation. (Bear in mind, however, that the 400-Mc signal could have a signal strength several times that of the true signal and show up as a larger amplitude presentation than the true one).

Also, an 800-Mc signal, if present at the input, would beat with the 2nd harmonic of the L.O. and produce the 200-Mc i.f. difference signal. Likewise, the 3rd harmonic of the L.O. — 900 Mc — could beat with a 700-Mc input, or a 1,100-Mc input and produce the 200-Mc i.f. frequency!

Fortunately, these harmonic-caused spuri can be easily recognized. Increasing the L.O. frequency by 100 Mc, for example, increases the 2nd harmonic by 200 Mc, and the 3rd by 300 Mc. Thus, harmonic spuri move across the screen faster than true response or images.

Assume inputs of 700, 400 and 100 Mc. The L.O. is set at 300 Mc to display the 100-Mc signal at the centre of the crt. The dispersion is set at 10 Mc, each centimetre representing 1 Mc on the crt. At the centre of the crt, only one signal is observed. Actually, three signals are present — the true signal which is L.O. minus the input frequency of 100 Mc, 2 x L.O. minus the input frequency of 400 Mc and 3 x L.O. minus the input frequency of 700 Mc. All these differences are exactly 200 Mc! See Figure 6.

Tuning the L.O. up 1 Mc in frequency will shift the true signal, 100-Mc, exactly 1 division to the

right (remember that tuning higher in frequency shifts true signals towards the minus-frequency or right hand side of the crt). The 1-Mc shift upward caused the 2nd harmonic to increase 2Mc, and this moved the 400-Mc input two divisions to the right! The 3rd harmonic increased by 3 Mc, and the 700-Mc signal appeared three divisions to the right of centre.

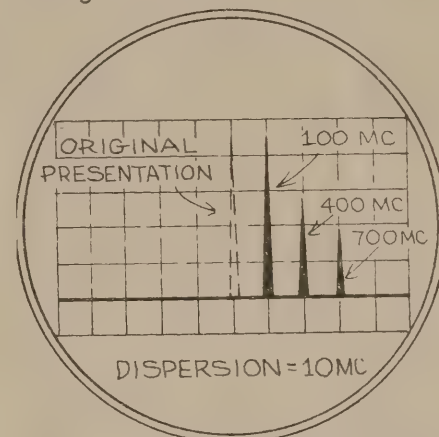


Figure 6. Display showing effects of moving tuning dial up 1 Mc to recognize and separate spuri from true response.

Assuming inputs of equal signal strength, the 2nd harmonic signal would be less than the amplitude of the true response and the 3rd harmonic signal amplitude would be less than the second. Unlike images, moving the L.O. up in frequency causes these harmonic spuri to move in the same direction as true responses.

MARKER OSCILLATOR

A feature of the spectrum analyser is the marker oscillator. It generates a 200-Mc signal which is fed into the 1st i.f. of the analyser. It can be used to determine relative frequency or frequency difference of signals observed on the crt.

It is remembered that the centre frequency of the 1st i.f. is 200 Mc. The marker frequency of 200 Mc is injected into the i.f. and will exist at the centre of the bandpass of the i.f. It can be said therefore, that the 200-Mc marker indicates the centre frequency of the i.f. and is displayed at the centre graticule line of the crt. The marker appears as a spike, or "pip", much like the time marks used to calibrate oscilloscopes.

A front-panel control, the "frequency-difference control," allows the marker to be tuned to either

side of its 200-Mc mid-range, usually plus or minus 30 Mc (170 Mc to 230 Mc). Figure 7 gives an example of the use of the marker.

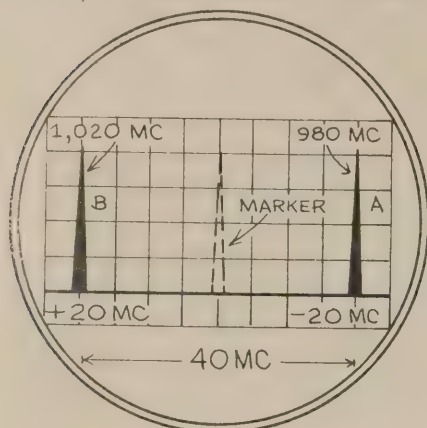


Figure 7. Dispersion is 50 Mc. Each cm = 5 Mc. Marker reads frequency difference.

First, the marker "pip" and the signal at "A" are lined up. The control reads —20 Mc. Moving the marker over to signal "B" and lining them up, the control reads +20 Mc. The frequency difference is 40 Mc and that is the frequency difference between signals "A" and "B". Assume the main-tuning dial is tuned to 1,000 Mc. The dispersion is set at 50 Mc. Each graticule mark now represents 5 Mc. No signal appears at the centre graticule line, which represents the centre frequency. Therefore, no input at 1000 Mc is present at the input of the analyser. However, there is a signal 4 graticule lines to the left of the centre one. This signal is 20 Mc less than the 200-Mc centre frequency, or 180 Mc, and corresponds to an original input of 1,020 Mc. The signal on the right, "B", is 20 Mc greater than 200 Mc and is produced by an input of 980 Mc.

As shown previously, spurious inputs will also produce similar signals on the crt. An input of 1,380 Mc will produce a signal similar to "A" and an input of 1,420 Mc will produce one similar to "B". Note that in the case of these and any images, frequency is read from left to right, in the normal fashion. True signals can be identified by shifting the main-tuning dial and observing which way the signals move on the crt.

The marker-oscillator output can be frequency-modulated, also. Two modulating frequencies are available on this typical analyser: 1 Mc and 100 kc. When modulated, the

200-Mc marker signal now becomes a complex waveform which the analyser will break down into individual sine-wave components (which is what the analyser does to all complex waveforms). These are displayed on the crt as pips, spaced equally apart. These pips extend to the right and left of the marker centre-frequency displayed on the crt. The separation between the pips is equal to the modulating frequency that caused them. In other words, with a dispersion of 10 Mc and the marker set on 200 Mc, a modulating frequency of 1 Mc will create a "pip" at each graticule line. These pips are called the "picket fence."

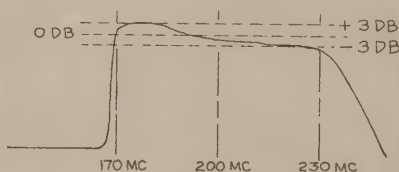


Figure 8. Bandwidth of 1st i.f., reproduced on crt by sweeping constant input signal over 60 Mc range. Note that despite constant input, there is a 6 db variation between 170 Mc and 230 Mc.

VERTICAL AMPLITUDE MEASUREMENTS

Look at the graphical view of the bandwidth of the 1st i.f. (Figure 8). The centre frequency is 200 Mc. Bandwidth limits are 170 Mc to 230 Mc and is expressed in db variation, usually ± 3 db. The figure shows that the flat portion of the curve can vary between minus 3 db and plus 3 db. This is a 6-db variation! Perhaps at the 170-Mc point, the response is +3 db. At the 230-Mc point, it could be —3 db. A single, constant-input signal, swept from 170 to 230 Mc, would produce an output to the detector that varies between +3 db and —3 db. Obviously, this same signal viewed on the crt would assume a varying vertical deflection at different points along the horizontal axis although the input had not changed at all. Therefore, it is important that all measurements using the spectrum analyser be made with the signal under measurement lined up at the centre graticule line. Thus, a constant output from the detector is assured.

To measure relative differences in amplitude of signals displayed

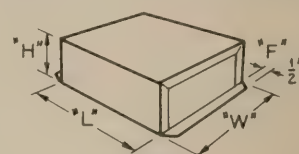
on the crt, the calibrated attenuator of the analyser is used.

Assume there is a crt display of two signals of different amplitudes. The detector is in the linear mode. The largest signal is reduced, with the attenuator, to the original amplitude of the second signal. The difference is noted on the attenuator. This is the relative difference. For signals of greatly different amplitude, the log mode of detection may be used. If the input signals were nearly the same amplitude, the square-law detection mode could be used.

This discussion has presented the overall operation of a typical spectrum analyser. Although product line features several there are many different models covering other portions of the electro-magnetic spectrum, some of which operate a little differently than explained here, they all do one basic thing. They break down complex waveforms and display them on an oscilloscope as individual sine waves on a frequency time base.

ENQUIRY CARD AD. 11

RADIO CHASSIS



AND

STEEL CABINETS

MADE TO ORDER

We can supply to order in any quantity BLANK CHASSIS in ALUMINIUM, ALUMINIUM ALLOY or ZINETC (Zinc coated steel) and are especially set up to handle economically small quantity orders.

ALSO STEEL CABINETS & PANELS CAN BE MADE TO ORDER AND SUPPLIED EITHER PAINTED OR UNPAINTED.

We can generally offer a two-day service for one-off orders.

When ordering please state:—
L x W x H x material and gauge and whether inside or outside mounting flanges are required.

(see illustration above)

Preferred Height of Chassis 2".

Write for pamphlet on chassis and cabinets.

INDUCTANCE SPECIALISTS LTD.

Cameron Road, South,
Greerton, TAURANGA

SERVICEMAN'S COLUMN

Conducted by J. Whitley Stokes

Some time ago whilst talking to a colleague the conversation moved around to the subject of my writing this column, and surprise was expressed that I should thus be wasting my time. As he put it: "Surely it doesn't have any advertising value for you." I agreed that this indeed was true, but had difficulty in convincing him that whatever my motives might be, the idea of the column having personal advertising value was not one of them.

Nevertheless an occasional, and sometimes unusual, job does turn up as a result of my literary efforts, and such a case is the one now described.

My first introduction to the job was when an acquaintance in the trade range up and asked if I would undertake the repair of a closed circuit TV monitor of German manufacture. Although not having had any previous experience with such apparatus I reasoned that it should not be so very different from a domestic TV receiver so I agreed to see what could be done. The monitor was duly brought in to the shop with the story that it had ceased functioning and a preliminary check by the firm concerned had indicated that the line output transformer might be faulty.

Thus the first request was for a preliminary check of their diagnosis and with the aid of the faithful flyback checker, which indicated the seemingly inevitable shorted turns, I was able to confirm their initial suspicion:

"Got a service manual for it?"

"No"

"Got any spare parts?"

"No".

What a chance for a few well chosen sarcasms but I let it pass. Instead I waited for any helpful suggestions, the first of which was "Perhaps you could use a stock replacement transformer." This I very much doubted as in the interests of high definition the monitor worked on 900 lines, or thereabouts, according to my informant.

"Air freight from Germany",

I suggested and this was agreed upon. Meanwhile, would I see if anything could be done, as the unit was wanted urgently?

After removing the defective transformer, which incidentally was some job, I examined it closely for any indication of arcing or overheating but so new and shiny looking was it that I found it hard to believe that it could be defective. Still 'old faithful' had never been known to lie and I had already substituted new line output and booster diode valves and checked for drive before removing the transformer. No, it just had to be faulty in spite of appearances to the contrary. On this basis I decided to remove the overwind from the ferrite core, because it was in this particular winding that the trouble lay. At this stage I had some vague idea of fitting an overwind from another transformer and so proceeded to slide the winding off the plastic former. As it slipped off leaving the bottom layer still adhering to the former the cause of the trouble was immediately apparent, arcing had taken place between the final two or three layers. Still visible were signs of 'green spot' corrosion on the surface of a layer of a certain notorious pressure sensitive tape used as insulation. In spite of the arcing and corrosion the winding checked OK for continuity, which explained why it had been possible to get a shorted turns test on it. As the arcing was confined to the bottom layers of the coil the thought occurred that it might be possible to remove the affected portion by unwinding a few

layers. This I proceeded to do and after building up the diameter of the plastic former with high-voltage tape the coil was re-assembled and waxed. Now it only remained to refit and wire up the complete transformer and after this was done the line output stage was back to normal with a very nice, well focussed raster on the 17 inch 90° tube. After letting it run all day on soak I duly rang up the person concerned and informed him that I had been able to get the monitor functioning again although on a "patch up" basis only. I suggested that if he cared to take it on the understanding that no guarantee could be given, it had every chance of lasting at least until a replacement transformer could be obtained. This he was glad to do and delivery was accepted on this basis.

Some two months later I received a phone call from this same source regarding the same monitor but this time the suggestion was that it had failed from a different cause. If he brought it over would I . . . ? I would. This time the story was that when the monitor had failed, in its down country location, a local serviceman had been called in, in the hope that it was "just a valve." The serviceman had diagnosed trouble in the power supply and as I was soon to discover he was quite correct. At this point he had suggested the monitor be returned to Auckland and I can't say I blamed him either. I would certainly have done the same thing under the circumstances.

When the unit again reached

Continued on Page 29

A brief description is given of the present method of generating field interlace synchronizing pulses for television systems. A new approach ⁽¹⁾ is described whereby most of the disadvantages of the present method can be overcome using pulse techniques. The new method can be applied in two ways both of which are described. One of these methods is extended to provide pulses for an eight field interlaced picture. Final results of these systems are shown to give good performance at greatly reduced cost and complexity.

Field Interlace System For Closed Circuit Television

*By A. B. E. Ellis, A.M.Brit.IRE

The basic requirement for obtaining field interlacing synchronizing wave-forms is to make up the complete picture using an odd number of lines. ⁽²⁾ (e.g. 405, 525, 625). The present method makes use of a dividing chain. The picture is divided into two consecutive fields each comprising an equal number of whole lines plus half a line. This ensures that any subsequent field will always start with a separation of half a line from the start of the current field.

In order to achieve this the line and field frequencies are synchronized and always contain a whole number of line periods plus a half line period. This is achieved by a frequency dividing chain from line to field frequency. The methods to be described achieve the extra half line using digital techniques.

General Description

In the existing method the line frequency is derived from a master oscillator of frequency equal to twice the required line frequency and the field frequency is obtained by counting down from this master oscillator.

Dividing circuits are not usually operated at division ratios greater than five if reliable operation is required.

A chain of dividers may therefore be needed to obtain the required ratio. Thus for a 405 line 50

field/sec. interlaced picture the system shown in block form in Fig. 1 may be used. In this system the master oscillator frequency is obtained from $202\frac{1}{2}$ line/field \times 50 fields/sec. \times 2 = 20,250 c/s.

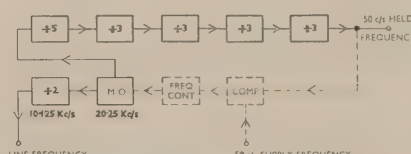


Fig. 1 Block diagram of a typical field interlace system.

If the field frequency is required to be synchronized to the supply frequency the output of the counter chain must be compared to the supply in a frequency or phase comparator circuit, from which an error voltage is derived and used to correct the master oscillator. This addition is shown dotted in Fig. 1.

This system has obvious disadvantages arising from complexity, cost and the amount of testing and setting up required. In most industrial closed circuit television chains (CCTV) a separate synchronizing waveform generator unit is pro-

vided if required, at additional cost to the customer.

A new approach was therefore considered starting with the basic requirement of the field interlace system, namely, that field interlace is achieved by producing successive fields differing in starting time by half a line period.

There are two methods of achieving this

- (1) By changing the timing of the line synchronizing pulses with respect to the field synchronizing pulse by a time equivalent to a half line at every field flyback.
- (2) By changing the timing of the field synchronizing pulse by a time equivalent to half a line at every field flyback.

Method 1 would provide a simpler and more accurate interlace but it suffers from the disadvantage of requiring a sudden jump in line timing equal to half a line period, once every field period, i.e. a timing shift of ± 50 per cent of line time with respect to one line period.

Method 2 requires little extra circuitry but requires a timing shift of only a small fraction of the field period, i.e. a timing shift of 50 per cent of line time with respect to field time; for a 405 line system approximately 0.25 per cent of field time.

Method 1. Line Synchronizing Adjustment

In this method the field synchronizing pulses are generated by the usual methods in the camera equipment and are locked to the supply frequency if required. A field time-base pulse is used to operate a bistable circuit to produce a square waveform at half the field frequency. This waveform is used to switch between two similar wave-

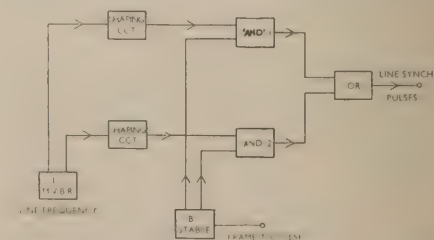


Fig. 2 Block diagram of a "Method 1" field interlace system.

forms which are antiphase to one another and are at line frequency.

The selected waveform is shaped to produce a narrow pulse suitable

for use as a synchronizing pulse for the line timebase circuits in the camera equipment. A block diagram of such a system is shown in Fig. 2, with associated waveforms in Fig. 3. It will be seen that the bistable edge occurs slightly later than a multivibrator edge. This will always be the case, due to delays in the camera field timebase circuits.

Taking any field at random, let 'And 1' be open due to its bistable input. 'And 2' will therefore be closed by the corresponding antiphase bistable input. One output of the symmetrical multivibrator is now fed via a shaper circuit and 'And 1' gate to the 'Or' gate and is used as line synchronizing pulses. When the field timebase starts its flyback a pulse from the field timebase circuits in the camera chain is used to change the condition of the bistable circuit. Thus, in the new field 'And 1' will be closed and the gate 'And 2' will be open.

The antiphase waveform of the multivibrator is now fed via its shaper circuit and gate 'And 2' to the 'Or' gate to be used as line synchronizing pulses during this field. As the two multivibrator wave-forms are spaced by a half line period, the line synchronizing pulses will, on subsequent fields, also be displaced by half line period thus fulfilling the requirement that lines on subsequent fields shall be displaced by a half line period.

The degree of interlace maintained will depend upon the stability of the oscillator over a field period. If it is required to achieve interlace to a timing tolerance of ± 10 per cent of a line period then an instantaneous change of line frequency of less than ± 10 per cent is required. If a cumulative change at a uniform rate over a field period takes place, the permitted change per cycle of line frequency would be:

$$\frac{10 \times 2}{\text{No. of lines/picture}} \%$$

In the example of a 405 line picture this would require a uni-directional drift rate of less than 0.05 per cent of a line period per line period. Thus frequency drift from thermal effects and other factors having a time constant such that the rate of change of frequency

during a field period may be considered constant, is required to be kept below 0.05 per cent per line period. This is not a very stringent requirement as frequency changes as great as this are not generally sustained over a period of many lines.

The waveforms produce the ideal requirement of the half line change in line timing on each field flyback but a sudden change in relative phase of line synchronizing pulses (and hence of line frequency) of 180° causes a loss of synchronization at the start of each new field. The rate of recovery towards re-synchronization will depend upon the method used and, in the case of 'flywheel' synchronization, which has an inherently long time constant, the initial transient has not had time to settle before the next shift in timing occurs.

The resulting raster will appear synchronized to either the 'in phase' or to the 'antiphase' synchronizing pulses but will be unable to follow both. As most monitors employ a form of i.f. feedback or 'flywheel' synchronization further study of this method was abandoned.

Method II. Field Synchronizing Adjustment

In this method the extra half line difference between consecutive field synchronizing pulses is achieved by maintaining the line frequency constant and providing a shift of half a line period to each

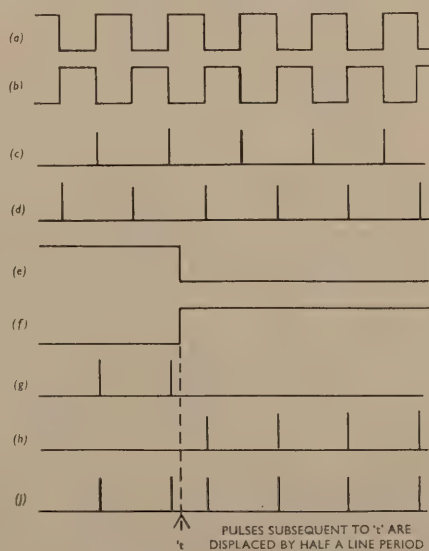


Fig. 3 Waveforms for the system of Fig. 2—(a) Multivibrator output 1; (b) Multivibrator output 2; (c) Shaper output 1; (d) Shaper output 2; (e) B stable output 1; (f) B stable output 2; (g) "AND" gate output 1; (h) "AND" gate output 2; (i) "OR" gate output.

consecutive field flyback. The advantages of this method are that the difficulties with line synchronizing circuits experienced in the first system are obviated and the line synchronizing pulse frequency remains constant. The change in timing of half a line on the field synchronizing pulses is sufficiently small to avoid the troublesome effects referred to above.

The line duration of a 405 line system is approximately $100\mu\text{s}$ giving a synchronizing pulse timing shift of $\pm 50\mu\text{s}$ in $20,000\mu\text{s}$ or ± 0.25 per cent. A block diagram of the system is shown in Fig. 4. The associated waveforms are similar to those shown in Fig. 3 in which waveform 'c' or 'd' is used for line synchronizing and waveform 'i' is further gated by a shaped pulse derived from the mains voltage to provide the pulses shown only during one part of the mains cycle. This provides the 'mains lock' if required.

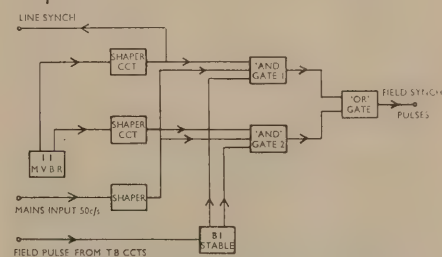


Fig. 4 Block diagram of the "Method 2" system.

In this description the mains locking circuits will be omitted at first. The two 'And' gates have similar inputs from the multivibrator via shaper circuits. These inputs are pulses at line frequency and of short duration with respect to a line period. One however, is displaced in time to lag the other by a half cycle of the multivibrator frequency. Either one or the other 'And' gate is alternatively switched on by the bistable circuit controlled by the field timebase pulse.

The output of each 'And' gate is combined to form a series of pulses suitable for use as field synchronization pulses. This combined output will comprise pulses derived from one edge of the multivibrator waveform during one field and pulses derived from the other edge for the following field. Thus, for a multivibrator having a mark-space ratio of unity, the resulting triggering pulses for the field timebase will be displaced by a half line

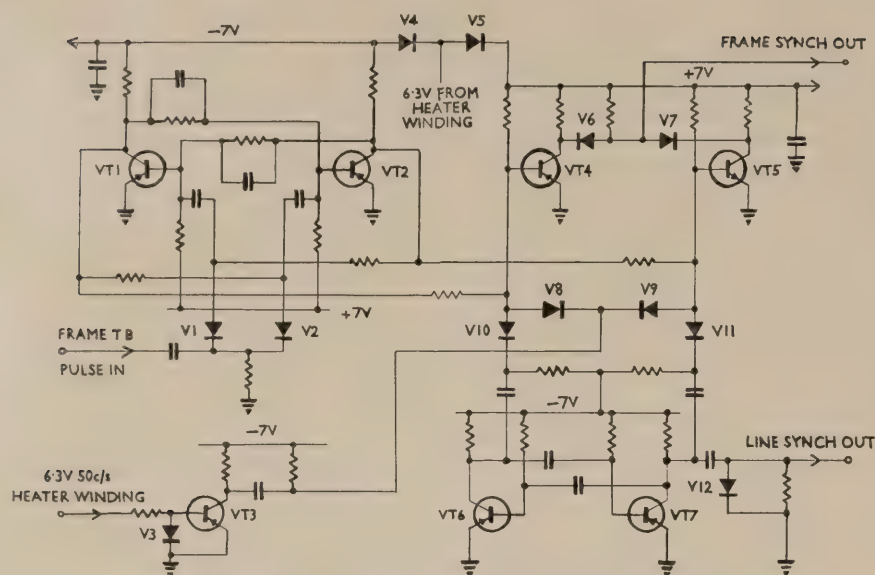


Fig. 5 Circuit diagram of the two-field interlace synch. gen.

every field. Line synchronizing pulses are obtained directly, or via a shaper, from the multivibrator.

In order to lock the field to the supply it requires only the addition of a third 'And' gate input common to gates 1 and 2. This input must occur once per mains cycle and last at least one line period but, in order to maintain a close lock with the mains cycle, should be as short as possible. This is obtained from a mains voltage via a shaper (Fig. 4). The synchronizing pulses are now inhibited except for the duration of this mains lock pulse.

The field pulse may be derived from the field timebase circuits to ensure that the bistable circuit does not change over until a synchronizing pulse has initiated the field fly-back. However, if this is not convenient, the circuit will function almost as well using the a.c. supply to operate the bistable circuit provided the field frequency is locked to the supply.

Figure 5 is a diagram of the circuit used in conjunction with a standard Industrial TV chain. Diodes V1 and V2 guide the incoming field timebase pulses to the appropriate half of the bistable circuit, VT1, VT2. VT6 and VT7 comprise the line frequency multivibrator feeding shaped pulses to be used directly as line synchronizing pulses and feeding the 'And' gates via V10 and V11. VT3 provides a suitably shaped pulse for use as a 'Mains Lock' gate. VT4 and VT5 select the

appropriate outputs from the 'And' gates, amplify them and feed them via the 'Or' gate, V6 and V7 to be used as Field synchronizing pulses.

Power supplies are provided by V4, V5 from a heater supply in the camera chain. The output synchronizing pulses are only roughly shaped as they are then fed to the camera chain which produces the correct synchronous shaped and combined synchronizing waveform.

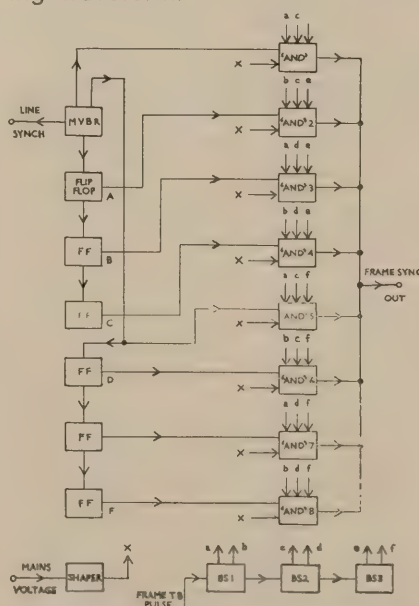


Fig. 6 Block diagram of an eight-field interlace system.

Application to an Eight Field Interlace System

The second method was adapted to produce an eight field interlace system as a means of bandwidth

compression. The picture comprised 1,000 lines at a picture rate of $6\frac{1}{4}$ per second. The flicker was reduced by means of storage in the camera and monitor tubes. It was comparatively simple to try the effectiveness of several different sequences of the eight fields in order to produce the best results without noticeable 'line crawl'.

The system used was as shown in Fig 6. The multivibrator operates at basic line frequency, which in this application, is 125 lines per field, or

$$\frac{20,000}{125} = 160\mu\text{s/line}$$

It provides the synchronizing for the timebase line of the camera and monitor.

The leading edge of one side of the multivibrator is fed to 'And 1' gate. A similar leading edge but delayed by $20\mu\text{s}$ is fed from flip-flop 'A' to 'And 3' gate. Similar delays are incorporated in flip-flop 'B' and 'C' feeding 'And 2' and 'And 4' gates. 'And 5' is fed from the other half of the symmetrical multivibrator while flip-flops 'D', 'E' and 'F' feed edges with similar and consecutive $20\mu\text{s}$ delays to 'And 6', 'And 7' and 'And 8' gates. Thus each gate has for an input a pulse at line frequency and phased at one of eight equal time delays throughout a line period (Fig. 8). The bistable pulses are combined in the 'And' gates to produce a series of eight consecutive pulses, each lasting for one field period (Fig. 7).

Omitting the mains lock input 'x' for the moment, the combined 'And' gate outputs will comprise each of the eight line frequency

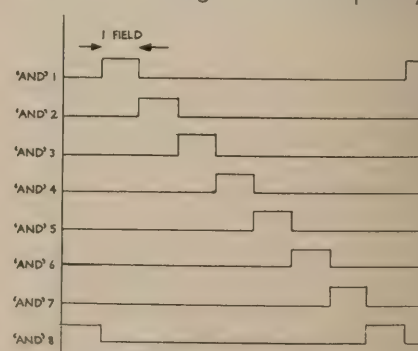


Fig. 7 Combined gate waveforms from bistables of Fig. 6.

pulses from the multivibrator and flip-flops in sequence. Each sequence will last one field period,

whereupon it will change to the following sequence. In order to achieve mains lock it is only necessary to hold off all 'And' gates until a given time with respect to the supply cycle. This is done by the output from the mains shaper circuit.

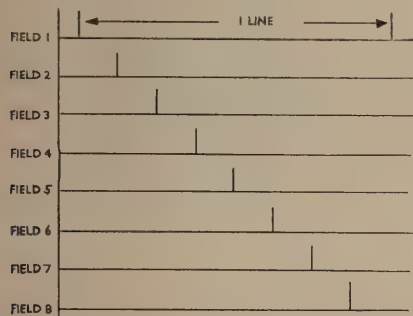


Fig. 8 Showing the successive delays in field synchronisation pulse.

Apart from a general flicker effect due to the low line repetition, a phenomenon known as 'line crawl' may occur due to successive lines 1 to 8 and 9 to 16 etc. being written in order and produced at the slow rate of 6.25 c/s. Each group of eight lines will take $1/6.25$ seconds to be written, the end of one group coinciding with the start of the following group of the second picture. As there are 125 groups of 8 lines in the system, a line will appear to 'crawl' down the raster in $125/6.25$ seconds i.e. in 20 seconds.

In order to reduce this effect it becomes necessary to write in a pseudo-random manner in which the timing effect is broken up. The order chosen became a choice of 1 8 2 7 3 6 4 5, or 1 6 2 5 7 4 8 3.

The circuit lends itself readily to experiment, as only the 'And' gate inputs from the multivibrator and flip-flops need to be re-arranged to provide the necessary change in the order of line selection.

From the point of view of the synchronization generation, the circuit worked very well enabling easy changing of the field order. When it became necessary to reduce the system to a four field interlace at 500 lines per picture, it was necessary only to remove the 'And' gate inputs from the final bistable circuit. No special components were used in any part of the circuitry.

Results

The following remarks are mainly concerned with the two-field

interlace system although some are also applicable to the eight-field system described.

The system produces a half line field spacing to an accuracy determined by the mark-space ratio of the multivibrator and by the short term stability of the multivibrator.

In a basic transistor multivibrator the frequency can be affected by:

- (a) component tolerances
- (b) rail voltage variations
- (c) temperature changes
- (d) ageing of components

In a Closed Circuit system the absolute number of lines is not usually required to be of great accuracy and if necessary a simple preset variation of the multivibrator timing can be incorporated to remove the long term effects of the above variations.

Short term effects which may affect interlace must be comparable in time to a field period. This generally rules out all of the above changes except (b) and transient variations of (c). Although supply rails can be fairly well smoothed to reduce ripple, remaining variations tend to affect both halves of the symmetrical multivibrator equally, with the result that the mark/space ratio and hence the interlace, remains relatively constant. Mark/space ratio variations occur only by virtue of component mismatch of each half of the multivibrator. Improved circuits of symmetrical multivibrators may be used where greater stability of interlace or line frequency is required.

As all the circuits used in the systems are of the switch type, variations of waveforms due to component tolerances are easily allowed for in the initial design.

Another way of reducing variations in line frequency and interlace would be to use a sine wave oscillator tuned to line frequency and sufficiently pure to provide a unity mark/space ratio. Antiphase waveforms may be obtained by means of a tapping on the oscillator coil. These waveforms could be squared and shaped before being fed to the 'And gate'. This should result in a more stable interlace at a stable line frequency which may be easily adjustable to different line standards.

Variables which may need to be incorporated in a multi-standard device are the line multivibrator

frequency and its mark/space ratio. All other components will operate over a range of line and field/frequencies. However the 'Mains Lock' gate should be large enough to admit the largest line period catered for.

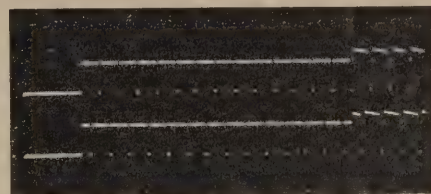


Fig. 9 Waveform of combined synchronisation pulses showing the relationship between line and field synchronisation on two consecutive fields.

In the design of the circuits it was found necessary to keep the width of the line pulses fed to the 'And' gates as narrow as possible in order to reduce variations in the field triggering time when the pulse coincides with the 'on' or 'off' edge of the 'And' gating pulses.

The output pulses of the synchronizing generator were used to trigger the existing circuits in the camera control unit in which were generated the usual mixed synchronizing waveforms. (Figs. 9 and 10).

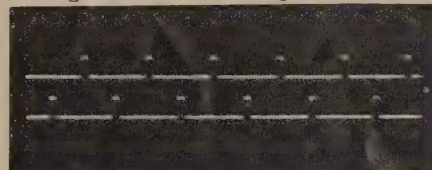


Fig. 10 Line synchronisation pulses on two consecutive fields showing the half line spacing required for an interlace picture.

Conclusion

A different approach to the problem of field interlace has been outlined. The results achieved have been described and appear to be satisfactory. Setting up has been much simplified and reliability improved by the use of digital techniques. The whole circuit including power supplies can be made into a very compact unit for addition to existing camera chains. The circuitry has been shown to be extremely versatile in its ability to be expanded to more complex field interlace systems and changes from one scanning standard to another may be simply effected.

References

- 1 Patent Application No. 8942/63.
- 2 Pannet Molloy, Radio and Television Engineers Reference Book, (Newnes), Sect. 20-3.
- 3 R. K. Richards, Digital Computer Components and Circuits.

focus on our agencies

New Nesco transistorized recorder has nine ranges, take-up reel and capillary pen. Exptaxial planar silicon transistors for low noise and stable operation from 0 to 55°C, nine ranges from 1 mv to 10v, adjustable zero control, 0.5% accuracy, automatic take-up reel, and capillary pen are features of the new NESCO 210 Transistorized Chart Recorder. Features include full span response (max. pen traverse speed) of 0.4 second, positioning of zero any place on chart or up to $\pm 50\%$ off chart by panel control, and choice of any two of sixteen available chart speeds. Price £368/10/0. Duty paid.



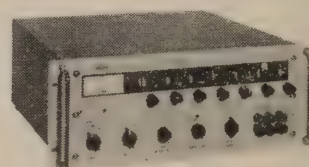
Datapulse NEW MODEL 111

2 NANO SECOND. Variable rise single or double pulse generator with precision dc baseline offset . . . 4 Hz to 40 MHz rep. rates . . . single or double pulse . . . $\pm 5v$ into 50 Ω D.C. offset to 5v . . . narrow pulses to 5 nanosec. Fully controllable fast pulses for exact waveform simulation . . . worst case testing. Precision dc baseline offset control for off-ground logic simulation, ultra high rep. rates for high speed circuit development. Auxiliary dc output for test biasing. Double pulses to 25 MHz (simulates 50 MHz) for flip-flop resolution checks . . . 10nS advance to 50mS delay. 5nS to 0.5mS. Pulse width rise and fall times separately variable linear 2nS to 500nS. Price £814/0/0. Duty paid.

John Fluke MFG. Co. Inc., announce a solid state voltage standard for use as a precision calibrator or voltage reference source.

Designated the Model 332A, the new instrument will deliver any desired output voltage up to 1111 volts with an accuracy of 0.003%. Line and load regulation is 0.0005% of setting. Output current is 0 to 50 ma at any output voltage.

Stability is $\pm 0.0015\%$ per week of $\pm 0.0025\%$ per month. Temperature co-efficient is 0.0002% of setting per °C from 0°C to + 50°C. Ripple and noise, less than 20 μv rms @ 10v range, less than 40 μv rms on 100v range. Seven in line decade switches provide 0.1 ppm resolution on each voltage range. Price 1369/10/0. Duty paid.

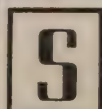


WE ARE SOLE AGENTS FOR:

BOONTON RADIO COMPANY (U.S.A.)
DECKER CORPORATION (U.S.A.)
EITEL-McCULLOUGH INC. (U.S.A.)
FAIRCHILD INTERNATIONAL
HEWLETT-PACKARD ASSOCIATES
KEITHLEY INSTRUMENTS INC. (U.S.A.)
MIKROS INCORPORATED (U.S.A.)
NUCLEAR CHICAGO
RADIATION INSTRUMENT DEVELOPMENT
LABORATORIES INC. (U.S.A.)

A/S DANBRIDGE (DENMARK)
DU MONT LABORATORIES (U.S.A.)
ELECTRONIC MEASUREMENTS CO. INC.
JOHN FLUKE MFG. CO. INC. (U.S.A.)
HEWLETT-PACKARD COMPANY (U.S.A.)
MELABS (U.S.A.)
F. L. MOSELEY COMPANY (U.S.A.)
GEORGE A. PHILBRICK RESEARCH INC.
SANBORN COMPANY (U.S.A.)
TALLY CORPORATION (U.S.A.)

DATAPULSE INCORPORATED (U.S.A.)
DYMEC INCORPORATED (U.S.A.)
ELECTRO SCIENTIFIC INDUSTRIES (U.S.A.)
HARRISON LABORATORIES
HOLT INSTRUMENT LABORATORIES (U.S.A.)
MICA CORPORATION (U.S.A.)
NESCO INSTRUMENTS INC (U.S.A.)
RADIO FREQUENCY LABORATORIES (U.S.A.)
S-E LABORATORIES LTD. (ENGLAND)
TECHNICAL RESEARCH GROUP INC. (U.S.A.)



SAMPLE ELECTRONICS (N.Z.) LTD.

8 MATIPO STREET, ONEHUNGA, S.E.5, AUCKLAND, NEW ZEALAND

TELEPHONE 567-356

SERVICE AND
CALIBRATION
FACILITIES
AVAILABLE

SERVICEMAN'S COLUMN

Continued from page 23.

my hands my first interest was in finding out how the patched up L.O.T. had fared and upon putting it to the test discovered that it had again broken down, but as things turned out there was more in store. Firstly the L.O.T. failure was of a much more drastic nature in that very obvious arcing had taken place from the E.H.T. winding to the ferrite core. The plastic former and part of the winding were badly charred so my first request was for the replacement transformer — which incidentally had not yet arrived. I was informed that a cable had been sent to Germany so meanwhile it was just a matter of waiting.

Eventually the transformer came to hand and I lost no time in installing and wiring it up. Before switching on a check was made for shorts on the B+ line, but nothing seemed amiss. How-

ever as soon as the valves warmed up a loud sparking could be heard apparently emanating from inside the selenium power rectifiers. Even before I had time to switch off my nose was assailed with the familiar stench (and I do mean stench, it was so bad that I had to open the window) of rotten cabbages, so characteristic of a selenium rectifier which has failed in the line of duty. Actually there were two of them, each a 250 mA bridge unit, hooked in parallel. The reason for this apparently unorthodox arrangement was that 250 volt selenium rectifiers are not made in over 250 mA rating and as the current requirement was in the order of 300mA or so it was necessary to use two rectifiers. Briefly to conclude the story, the rectifiers were by now defunct but the immediate problem was to locate the cause of their demise. The B+ line had previously been checked for shorts so what could account for the excessive current? Also why

didn't the fuses blow? Further checking revealed a shorted booster diode and examination of the fuses showed that the original 400mA ones in the primaries of the power transformers (there were two transformers) had both been replaced with 2A.

Hah! The plot thickens. Now the picture was apparent. The arcing in the L.O.T. had apparently caused the booster diode to fail with resultant blowing of the 400mA primary fuse. As another fuse of the correct size was not available the 400mA one in the primary of the other power transformer, which supplied heaters only, had been robbed and when it also blew, 2A fuses had been inserted in both primary circuits. With the safety valve thus removed the excessive H.T. current had proved too much for the selenium rectifiers.

Maybe I should have checked the amperage of the fuses before switching on and thus the rectifiers might have been saved but I had a pretty strong suspicion that the damage had already been done beforehand. Anyway after fitting new rectifiers and a booster diode normal operation was restored once more. Again a full day's soak test at the end of which the job was passed A1 at Lloyds. Wonder how long the replacement L.O.T. will last!

ADVANCE IN COLOUR TELEVISION

With colour television now making major advances in the consumer market, manufacturers throughout the world are scrambling to gain a share of the huge potential market. The vast Philips organisation believe they have achieved a technical break-through with development of their Plumbicon colour television camera which has won wide acclaim in many countries, including the U.S.A. and Japan.

To viewers, the most impressive advance was the appearance of natural shadows on their screen. Previously, shadows were absolutely forbidden in colour television studios because of the green hue they created. The Plumbicon camera, however, is claimed to reproduce shadows with the same accuracy as scenes in bright light.

The working principle of the Plumbicon has similarity to that of the vidicon. Both tubes are based on photo-conductivity, superior to photo-sensitivity in the efficiency with which it transforms light into electric current.

Employing a different light sensitive layer, the Plumbicon differs considerably in performance with the vidicon. In the first place the

tube is more sensitive, and has a high signal-to-noise ratio even at low illumination levels. Moreover, image lag is practically absent, which means that a light coloured object moving rapidly across the screen will cause no streaks. A further important aspect of the Plumbicon is its linear relationship between light level and signal current, which allows for perfect matching of the cameras in a studio.

Non-linearity causing extraneous colouring of shadows, the straight light transfer characteristic also explains its excellent colour response to shady scenes. Its dark current is almost negligible, which guarantees better video tape.

The camera's size, weight and flexibility suits studio use or outside broadcasting. The camera with 10 to 1 servo-controlled zoom lens is of the same size as competitive black-and-white cameras. One hundred foot candles are enough to give broadcast quality pictures. Acceptable pictures can be obtained at as low as 25 foot candles.

In standard version the camera is fitted with a 6.5 inch electronic

viewfinder and a fully servo-controlled zoom lens. Two lenses are available: Angenieux 1:2.2 f = 18 . . . 180 mm and Varotal IX SP 1:2 f = 20 . . . 200 mm. Focusing and zooming is from the camera; adjustment of the diaphragm is remote-controlled from the camera control unit.

The colour splitting system of the camera is so compact that there is no need for relay optics and other auxiliary lenses. As a result picture contrast and sharpness are greatly improved. Circuitry of the camera and camera control unit are fully transistorised, except for the input stages of the three pre-amplifiers, which consist of a two-Nuvistor cascode stage, giving optimum signal-to-noise ratio.

The solid-state circuitry explains the short warm-up time. A rehearsal quality picture can be obtained two minutes after switch-on.

Electronics in Action

Papers Provisionally Accepted For National Conference

The response to this conference has been overwhelming, both from the authors of papers and from those wishing to enrol. It is almost certain, however, that there are many people connected with electronics who have not yet enrolled for the conference and a second circular was recently distributed reminding people that the reduction for conference fee would cease after the 15th June.

Papers submitted to the conference cover a wide and extremely interesting range of topics and it is clear that all will be of a

very worthwhile standard. There will be something of interest to everyone in the electronics field whether they be in research or development, or in fact merely interested in recent developments.

Arrangements are being made where possible to supply to all who enrol, preprints of the papers being presented to the conference and in addition it is proposed to prepare an edited edition of the conference proceedings including discussion.

A gratifying response has been received from the organisations who were approached

to participate in the conference and also from firms selling electronic equipment. Over twenty firms are displaying equipment and a number of static displays by Government Departments have been offered.

If sufficient interest can be raised excursions to such places as Mangere International Airport or to the NZBC Television studios will be arranged.

For those attending the conference it will be a full, interesting and stimulating three days.

Participating Organisations include—
N.Z. Electronics Institute (Inc.)
Institution of Electronic & Radio Engineers
V.H.F. Group (Inc.)
Institute of Physics (N.Z. Branch)
N.Z. Broadcasting Corporation
Department of Education
N.Z. Railways
Department of Scientific & Industrial Research
Ministry of Defence
Royal New Zealand Navy
Royal New Zealand Air Force
New Zealand Army
Department of Health
N.Z. Forest Service
N.Z. Post Office
Department of Civil Aviation

The two evening sessions are
Wednesday, August 17th:

Discussion led by Cdr Beere (RNZN), Secretary of the National Electronics Research Council—
"The National Electronics Research Council: Relations between industry and government research departments."

Thursday, August 18th:

Social Function and GET TOGETHER.

ENQUIRY CARD AD. 14



Quality audio transformers from Redfern

Our Transformer Dept. specialises in this type of component.

We also produce

Mains Transformers,
Filter Chokes, Specials.
For Better Quality
Equipment.

FEATURES:

Wide Response, Low
Distortion.
Good Transient Response.
Interleaved Windings, Core
Material.
Grain Oriented Steel or "C"
Cores.
For Public Address or High
Fidelity Sound Systems.

REDFERN RADIO

4113 GT. NORTH ROAD

GLEN EDEN

TELEPHONE 889-280



TITLES OF PAPERS PROVISIONALLY ACCEPTED TO DATE

Abbreviations used in this list:

AWA — Amalgamated Wireless A'sia (NZ)
Ltd

AIDD — Auckland Industrial Development
Division, D.S.I.R.

ATI — Auckland Technical Institute

EDAC — Electronic Development &

Applications Co. Ltd
Inst. of Nuc. Sc. — Institute of Nuclear
Science

NRL — Naval Research Laboratory

MOW — Ministry of Works

NZBC — New Zealand Broadcasting

Corporation

NZPO — N.Z. Post Office

NZR — N.Z. Railways

PEL — Physics and Engineering Laboratory,
D.S.I.R.

Pl. Chem. Div. — Plant Chemistry Division

UoA — University of Auckland

VUW — Victoria University of Wellington

Section A: DATA HANDLING

Convenor: Dr D. J. Barnes

Digital Voltmeter and Tape Punch Equipment
for the Automatic Recording of Data, M. J.
Beale, PEL, Gracefield. A Digital Programming
System for a Large Environmental Control
Installation, W. P. Gabriel, PEL, Gracefield.
Switching Characteristics and Digital Appli-
cations of Tunnel Diodes, J. B. Earnshaw,
Physics Dept., UoA.

Transient Characteristics of Series-connected
Tunnel Diodes, Z. C. Tan and J. B. Earnshaw,
Physics Dept., UoA.

A Transistor-diode Feedback Logic Circuit,
P. M. Fenwick and J. B. Earnshaw, Physics
Dept., UoA.

Peripheral Equipment for Digital Computers,
A. E. J. Pitchforth, Data Processing Division,
Armstrong and Springhall Ltd.

Data Acquisition Facilities for Nuclear Physics
Research at the Institute of Nuclear Sciences,
K. Bargh and G. McArthur, Inst. of Nuc. Sc.,
Gracefield.

The Effect of Solid State Devices on Analogue
Computing, B. L. Bulford, E.A.I. Electronic
Associates Pty., Australia.

Low Cost Digital Computing for Engineers,
R. A. Cooke, E.A.I. Electronic Associates
Pty., Australia.

The Application of Analogue Computer to
Acoustic Ray Tracing in the Ocean, L. Light,
NRL, Auckland.

Integrated Circuit Logic Elements: Applications
and Design Problems, D. J. Barnes, NRL,
Auckland.

Applications of Digital Computers in Modern
Mathematics, E. Jones, Applied Mathematics
Division, DSIR, Wellington.

Digital Data Telemetry, E. R. Grant, A. M.
Tait Ltd., Christchurch.

Section B: MODERN COMMUNICATIONS

Convenor: Cmdr. H. Luton

Satellite Communications, E. de Lisle, NZPO.
Compac — the Submarine Communication
Links, A. Giffins, NZPO.

V.H.F. Mobile Communications, R. Cassey,
NZPO.

An Integrated V.H.F. and U.H.F. Commu-
nications and Telemetry Bearer System, P.
Bingley and K. Shankland, PYE (Telecommu-
nications) Ltd.

Colour Television Systems, NZBC.

Television Receiver Circuitry Developments,
J. Howe, EDAC.

Design and Development of a Television
Tuner Unit to Suit New Zealand Conditions,
K. A. Tribble, Akrad Ltd.

Advanced Developments in Studio Television
Cameras, R. B. Gordine, AWA.

Multi-Channel Telephony on Broadband
Bearer Systems, W. T. Lack, NZPO.

A Tuneable Phase-locked V.L.F. Receiver with
Digital Servo, N. Polletti, PEL, Gracefield.

A Novel Frequency Synthesiser with Multiple
Output for use of the Band 10-100 Kc/s, as
a Local Oscillator for V.L.F. Receivers, I. R.
Richards, PEL, Gracefield.

Discussion Panel on Frequency Standards in
New Zealand.

V.L.F. Propagation Investigations in New
Zealand, G. J. Burt, PEL, Gracefield.

Section C: RESEARCH ELECTRONICS

Convenor: Mr P. H. Barker

A Spectrum Analyser for M.L.F. Signals re-
ceived via the Whistler Mode, G. L. Jones,
PEL, Gracefield.

A Parametric Amplifier for use at Sub-audible
Frequencies, J. H. Buckingham, PEL, Grace-
field.

Design and Use of Thin Film Distributed Filter
Networks, K. J. Gough, 12 Coombe Street,
Wellington S.I.

Equipment to Measure Elastic Constants and
Internal Friction in Rods, R. E. Booker, UoA.

Portable Light Integrator for Microclimate
Investigations, R. W. Robotham, D.S.I.R.,
Palmerston North.

A 40 Mc/s Solid State Total Power Radio-
meter, B. Egan, School of Eng., UoA.

An L.F. Broad Band Antenna Array for Radio
Astronomy, B. Egan, School of Eng., UoA.

The Measurement of Noise in Hydrophone
Amplifiers, J. M. Tricker, NRL, Auckland.

Electronic Measurement Systems in Marine
Physics, P. H. Barker, NRL, Auckland.

Section D: INDUSTRIAL ELECTRONICS

Convenor: Mr H. Tollenaar

Power Control Using Silicon Controlled Recti-
fiers in an Environmental Control Installation
with a Switching Capability of 0.5 Mega-
watts, W. P. Gabriel, PEL, Gracefield.

Profile Milling by Programmed Numerical
Control, R. A. Morris, PEL, Gracefield.

Closed Circuit Television at the Maximum
Security Villa at Lake Alice Hospital near
Marton, T. G. Proctor, MOW.

Railway Signalling — Electronic Remote Con-
trol, R. B. McCorkindale, NZR.

Strain Gauge Measurements, L. W. Harrison,
EDAC.

Electronic Weighing and Batching, B. Pidgeon,
EDAC.

Reliability from the Standpoint of Manu-
facturers and Users, I. E. Nixon, VUW.

Section E: MEDICAL ELECTRONICS

Convenor: Mr A. W. Melville

Use of Water Potentiometers in Recording
from Exteriorisations in Sheep, D. W. Web-
ster, Pl. Chem. Div., DSIR.

Foetal Monitoring, B. E. Cornwall, AIDD.

Patient Monitoring, G. Rust, Physiology Dept.
Green Lane Hospital, Auckland.

A Daylight Integrator, R. A. Morris, R. Robot-
ham, PEL, Gracefield.

An Omnidirectional Anemometer for Plant
Physiology Study, A. R. Morman, PEL, Grace-
field.

Section F: ELECTRONICS IN AVIATION

Convenor: Mr R. Gager

The Low Approach Mode of Instrument
Landing.

Auto-pilots and Flight Directors, B. Taylor,
Air New Zealand.

Radio Navigation Aspects, W. Keen and E.
Symmons, Air New Zealand.

Flight Testing of Aircraft Electrical Systems,
G. E. Jones, NRL, Auckland.

Section G: NUCLEONICS

Convenor: Mr A. Ross

Instrumentation in Cosmic Ray Research, Mr
Gough, Physics Dept., VUW.

Instrumentation in Carbon 14 Dating, H.
Jansen, Inst. of Nuc. Sc., Gracefield.

A Portable Alpha Counter for Investigation
of Very Low Level Activity in Food, Tobacco,
etc., R. A. Morris, PEL, Gracefield.

Nuclear Electronics at the University of
Auckland, J. J. Walker, Physics Dept., UoA.
General Purpose Logarithmic and Linear
Count Rate Meters, A. Ross, Chemistry Dept.,
UoA.

A Developmental Scalar/Timer for Radio-
chemistry, A. Ross, Chemistry Dept., UoA.
Control Electronics for Particle Accelerators,
B. A. McKinnon, Physics Dept., UoA.

Section H: ELECTRONICS EDUCATION

Training of Technicians in the Institutes of
New Zealand, M. A. Jillings, ATI.

Development in Electronic Education Overseas,
I. Turner, ATI.

The Electronics Engineer and the Technician
— Panel Discussion, B. H. Olsson, NRL; R. B.
Waddell, ATI; Cdr. G. Beere, RNZN.

Electronics in New Zealand Universities, D.
J. Clegg, UoA.

Automation in Education, R. MacBeth, Post
Primary Teachers College.

The Admittance Matrix: A Universal Approach
to Active Circuit Analysis, B. Egan, School
of Eng., UoA.

Electronics in Education, R. J. MacBeth, Post
Primary Teachers Training College.

The Training of Electronics Technicians, F.
Stephens, Wellington Polytechnic; M. A.
Jillings, ATI.

Matrices in Education, B. Egan, School of
Eng., UoA.

ENQUIRY CARD AD. 15



Our radio broadcast universal
replacement coils will replace any
damaged aerial, R.F. or oscillator
coil. Designed to assist you in
maintaining first-class service to
your clients.

Aerial Type 40

R.F. Type 45

Osc. Type 41

Write for alignment procedure
Sheet N° 5/40

New factory address:

Cameron Rd. South, Greerton, Tauranga

Inductance Specialists LTD.

ENQUIRY CARD AD. 13

DEPARTMENT OF CIVIL AVIATION TELECOMMUNICATIONS TECHNICIANS VARIOUS LOCATIONS

DUTIES: Maintenance of a wide and expanding range of electronic equipment which provide essential services for aircraft flying both within New Zealand and the South Pacific area for which New Zealand is responsible. Equipment to be maintained includes—

Communications (for both aircraft control and point-to-point services) which consists of H.F. and V.H.F. transmitting and receiving equipment, V.H.F. and microwave links, machine printing equipment, semi-automatic torn tape telegraphic switching centres, radio teletype transmission and reception, including automatic error correction equipment, single and independent side-band transmitters and receivers.

Navigational and Landing Aids: Surveillance radars, distance measuring equipments, V.H.F. direction-finding sets, V.H.F. omni-ranges valve and solid state navigational beacons, precision approach radars, instrument landing systems.

Meteorological Wind-finding and Weather Radars: Radio-sonde receiving and recording equipment, cloud ceilometers. Miscellaneous equipment includes pen recorders, multi-track tape recorders, facsimile equipment.

QUALIFICATIONS REQUIRED: First-class certificates in Radio Technology (or acceptable equivalent) with several years' recent experience working on electronic equipment. Applicants who have been continuously engaged on electronic work for a number of years, but lack the CRT will be considered in special cases and undergo a course of instruction at the Department's Aeronautical College at Christchurch.

GENERAL: Appointees will be given Special Equipment courses at Christchurch as required. There are opportunities for service overseas, where housing is provided. Housing is also available at some New Zealand locations.

SALARY: On appointment up to £1,105 per annum depending on qualifications and experience. Advancement to £1,210 per annum on merit. Promotions above £1,210 per annum are to established vacancies as Supervising Technicians.

For further details contact the Regional Superintendent at Auckland (Tel. 34-530), Wellington (55-760) or Christchurch (62-831), or write to the Secretary for Civil Aviation, Department of Civil Aviation, Private Bag, Wellington.

Applicants should preferably use Form P.S. 17A, obtainable from Post Offices and should enclose copies only of testimonials.

Assistance towards expenses will be given to a married man required to move his household.

ENQUIRY CARD AD. 16

DAWE INSTRUMENTS LTD.

Dawe Instruments Limited can supply you with measuring equipment for all your noise and vibration problems in modern occupations and industry.



The Model 1400F (as illustrated) noise meter has filter and recording connection facilities.

The Model 1408E is the popular low price hand held transistor noise level meter.

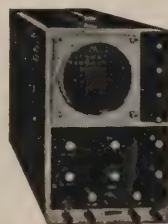
The Model 1419A Octave Band sound level meter is the complete analyser.

For complete information of ex stock models or models due to arrive contact our office. Dawe Instruments manufacture a full range of noise analysing vibration, ultrasonic cleaners, stroboscopes, etc.

HEATHKIT U.S.A.

DAYSTROM GREAT BRITAIN

The names that give you high quality low priced test equipment as kitsets or built up ready to use. Regular deliveries from overseas means we can supply your kitsets ex stock.



10 - 12 U
OSCILLOSCOPE

10-12 u Oscilloscope
The Heathkit low-priced 5" oscilloscope.

The V-7A Vacuum Tube Voltmeter from Daystrom, England. The most widely used vacuum tube voltmeter in New Zealand.



V - 7 A VTVM

Should you have any electrical test or measuring requirement contact our office for information and stock position.

ELEKON

(OVERSEAS) LTD.

PHONE 16-189 OR WRITE P.O. BOX 5146, AUCKLAND

National Electronics Research Council

—objects and membership

Last month we gave readers some details of the National Electronics Research Council and since that time we have received a copy of the draft Rules of the Council. These give, in legal form the objects of the body together with rules for membership and conduct of its business.

Below we have extracted those items which will be of interest. From these it will be seen that the electronics industry in this country will materially benefit from the setting up of this council. Indeed, we have already heard of several small firms who have enthusiastically pledged support.

(The paragraph numbers below are those followed in the draft rules).

OBJECTS.

3. The objects for which the Council is established are:—

- (A) For the sole purpose of benefiting the public to initiate, carry out, encourage and co-ordinate research in the field of radio and electronic science and engineering and so as to give effect to such charitable object but not further or otherwise:—
 - (i) to consider the requirements and priorities of research in the said field;
 - (ii) to make information and advice relating to such research available to any person or body (incorporated or unincorporated) engaged in or about to engage in such research;
 - (iii) to publish and distribute in any form and in any manner such information and the results of any such research;
 - (iv) to make grants, donations and other payments and to provide equipment by way of gift or loan to any person or body (incorporated or unincorporated) engaged in or about to engage in such research; and
 - (v) to advance education in the field of radio and electronic science and engineering.
- (B) To set up, equip, maintain and carry on research centres, laboratories and other scientific establishments.
- (C) To purchase, take on lease or in exchange, hire or otherwise acquire any real or personal property and any rights or privileges which

the Council may think necessary or convenient for the promotion of its objects, and to construct, maintain and alter any buildings or erections necessary or convenient for the work of the Council.

MEMBERSHIP.

4. The subscribers to the Application for Incorporation and such other persons as the Committee shall admit to membership in accordance with the provisions hereinafter contained shall be members of the Council.

5. Where any person desires to be admitted to membership of the Council he must sign and deliver to the Council an application for membership framed in such terms as the Committee may require.

SUBSCRIPTIONS.

7. The Council may, at a General Meeting, prescribe or alter the prescription of separate classes of members. The amount of the annual subscription in respect of each class of members for the ensuing year shall be determined by the Annual General Meeting and until the first Annual General Meeting may be determined by the Committee.

COMMITTEE OF MANAGEMENT.

19. The Committee of Management shall comprise not less than ten nor more than seventeen members of the Council appointed as follows:—

- (a) A Chairman elected at the Annual General Meeting.
- (b) Four members appointed by the contributing Government Departments and public corporations.
- (c) Two members appointed by the Vice-Chancellors of the contributing Universities.
- (d) Two members appointed by the contributing Engineering Institutions.
- (e) One member appointed by the National Committee for Radio Science of the Royal Society of New Zealand.
- (f) Four members appointed by the contributing firms engaged in the electronics industry in New Zealand.
- (g) Not more than three members appointed by the Committee as representatives of such special bodies or interests as the Committee deems desirable.

ENQUIRY CARD AD. 17

**spectrum
analysis**

with your Tektronix oscilloscope

... with these new Tektronix Spectrum Analyzer Units—which fit all Tektronix Oscilloscopes that accept letter-series or 1-series plug-ins.

You buy only the plug-in unit.

You have a complete spectrum analyzer at a fraction of the cost of other analyzers. You don't have to purchase, store, and maintain both an oscilloscope and a separate analyzer. It's the simplest way of spectrum analysis—for you're already familiar with the oscilloscope controls. Add the analyzer functions and you convert quickly and conveniently from time-based displays to frequency-based displays.

Several Spectrum Analyzer Plug-In Units — covering other frequency ranges — are available from Tektronix, and the McLean Servicing and Calibration Laboratory backs up every instrument.

Sole New Zealand representatives:—

W. & K. McLEAN LTD.

We maintain our own servicing and calibration laboratory in our Lower Hutt Office, 437 Hutt Road, Lower Hutt

CHARACTERISTICS	L-20	L-30
Frequency Range	10 Mc—4 Gc	1 Gc—10.4 Gc
Minimum Sensitivity	110—90 (-dbm)	105—75 (-dbm)
Dial Accuracy	15 kc to 60 Mc.	
Dispersion	Oscilloscope magnifier usable to 3 kc.	
Resolution BW	1 kc to 100 kc, variable	
Display	Log, linear, square law, video	

Be certain to see L20 Spectrum Analyzer at our stand during the National Electronics Conference in Auckland, Aug. 17-20.

P.O. BOX 3097, AUCKLAND. TELEPHONE 586-000
PRIVATE BAG LOWER HUTT. TELEPHONE 699-864

BOOKS

TRANSMISSION LINES ANTENNAS and WAVEGUIDES

by R. W. P. King, H.R. Mimmo
and A. H. Wing

Publ.: Dover Publications, N.Y.
pp. 347 Price: \$(U.S.) 2.50

The first edition of this book was published in 1945 after the realisation that a need existed for many trained radar personnel with a working knowledge of U.H.F. circuits. A course of lectures which served as a preparation for further training was devised and this book is the result of the preparatory course.

Twenty years later in 1965 the Dover edition appeared with little added material and the bibliographies updated to 1964. The state of the art has progressed so rapidly in these twenty years that this book has been left very much out of date. Electromagnetic theory, being treated largely on a non-mathematical basis, provides the reader with little more than an elementary introduction to the subject and omits or disguises some of the important fundamentals of the modern theory. As an example of this I quote from the beginning of chapter II, Antennas, the last sentence on page 71:—"But if one is willing to accept some things on faith and to meet others with an open, perhaps even an adventurous mind, a degree of familiarity with many electromagnetic phenomena can be acquired from a qualitative discussion."

Numerous superior works have been written on the subjects of transmission lines, antennas and waveguides and I therefore could not recommend this book to anyone wishing to become acquainted with the electromagnetic theory of these devices.

I.R.R.

DOVER REISSUES SIX MORE VOLUMES

Dover is reissuing in paperback six more volumes of the Massachusetts Institute of Technology Radiation Laboratory Series. Twelve volumes were issued last year.

The volumes in this series, under the general editorship of Louis N.

Ridenour, originated from the highly intensified research and development effort that went into the sophistication of radar and related techniques during World War II. The great body of information which was revealed, and the new techniques in the electronics and high frequency fields were seen to offer valuable material to scientists and electronics engineers, as well as to military personnel, and, therefore, as soon as security permitted, was prepared for publication by the Massachusetts Institute of Technology Radiation Laboratory, under the auspices of the National Defence Research Committee.

Each volume was written and edited by different authorities familiar with the field, but the material described is the collective result of work done at many laboratories — Army, Navy, university, industry — in the United States, England, Canada, and other Commonwealth countries, representing scientific investigations of so intensive and large a scope that it is unlikely that it will ever be duplicated.

Published first during the late 1940's and early 1950's, this series remains the only record of wartime research on radar and related fields. The following six volumes have now been released in paperback:

Klystrons and Microwave Triodes

by Donald R. Hamilton, Julian K. Knipp, and J. B. Horner Kuper. \$3.00.

The basic principles underlying the operations of klystrons and planar grid tubes as oscillators and amplifiers are covered in this volume. The treatment is vigorous, with technical and theoretical aspects of the field presented very thoroughly. Tubes operating in a frequency region above 3000 Mc/sec are emphasised.

Technique of Microwave Measurements edited by Carol G. Montgomery. 2 vols. \$2.00 each.

This still timely book is extremely useful for its detailed discussions of methods and devices for measuring various quantities pertinent in microwave technology. The methods described are, for the most part, based on the wave character

of high-frequency currents rather than on the low-frequency techniques of direct determination of current or voltage.

Microwave Receivers edited by S. N. Van Voorhis. \$3.00.

This volume offers a very full coverage of the design and operating principles of microwave receivers. Although post-war developments in the field have increased receiver sensitivity, the basic principles explained here are still indispensable to today's design of communication, navigation, and detection systems. The discussion includes a full treatment of individual types of receivers.

Electronic Time Measurements

edited by Britton Chance, Robert I. Hulsizer, Edward F. MacNichol, Jr., and Frederick C. Williams. \$3.00.

Precision measurement of very small intervals of time and distance is essential for radar work, television transmission and reception, and in navigation systems such as Loran. Dealing with both manual and automatic methods, the authors of this basic study investigate the various problems and techniques of obtaining accurate measurements in full.

Cathode Ray Tube Displays

Theodore Soller, Merle A. Starr, and George E. Valley, Jr. \$3.25.

This volume covers the theory and circuitry of cathode-ray tubes and their applications. The discussion is technical and quite detailed, with emphasis upon applications to radar displays and to test equipment. The tubes themselves are discussed primarily from a functional rather than developmental point of view. In so far as the theory and circuitry are concerned, the material is still up to date.

Radar Aids to Navigation edited by John S. Hall. \$2.75.

A lucid and largely non-technical analysis of the advantages and limitations of radar equipment when applied to navigational and piloting problems. The presentation, which includes detailed descriptions of airborne, shipborne, and ground-based systems is thorough, with all terms clearly defined. Although some equipment specifications are now out of date, the basic principles discussed are still essential.

ENQUIRY CARD AD. 18

sangamo

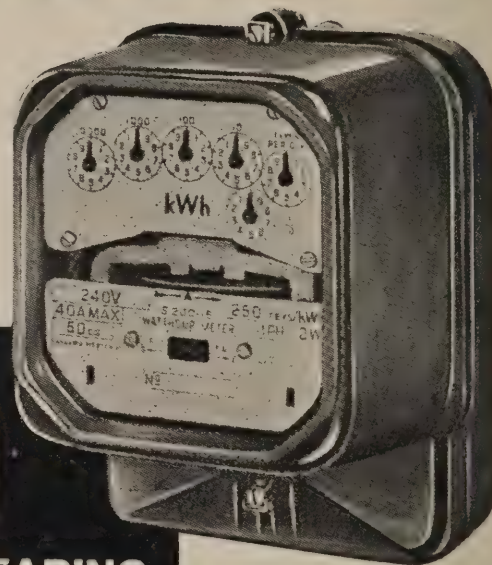
S200·16

SINGLE PHASE WATTHOUR METER

WITH

FLOTON

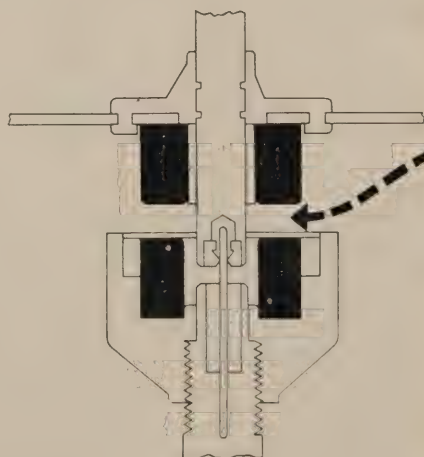
MAGNETIC FLOTATION BEARING



Already the Sangamo model S.200 meter is years ahead of its time. More iron and copper in both the potential and series elements to give a better load curve. Quantity production bringing economies which are passed on to the user in

finer materials, finer specifications. Quality control at every stage. And now Sangamo are first in production with magnetic flotation of the disc spindle, completely eliminating bearing wear . . . giving even longer life and sustained accuracy to the world's longest-life meter.

Disc spindle
completely
floats
on a
magnetic
cushion
eliminating
wear and
ensuring
sustained
accuracy

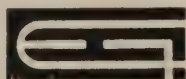


WIDE CLEARANCE IN REPULSION

SYSTEM One of the outstanding features of the system is the self-cleaning of the magnetic gap. The repelling fields of the floating magnets have a generous clearance of approximately $\frac{1}{16}$ " in depth and can readily be inspected from the front of the meter. These repelling fields prevent magnetic particles from bridging the magnetic cushion and thus creating a source of friction.

BARIUM-FERRITE CERAMIC MAGNETS

These magnets, of exceedingly high coercive force, cannot be de-magnetised by the most powerful magnetic field caused by extreme overload on the meter, or by external magnetic fields. Being ceramic, they are completely corrosion proof.



E. C. GOUGH LTD.

BOX 873

— PHONE 62-254 —

CHRISTCHURCH

BOX 8150 NEWTON — PHONE 16-100 —

AUCKLAND

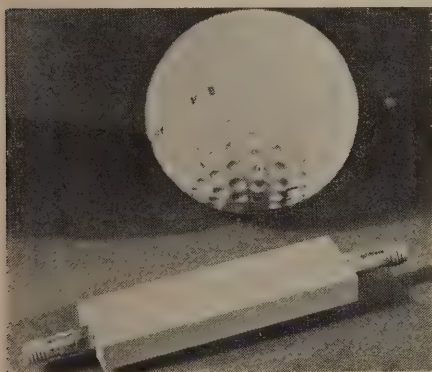
New Products

SUBMINIATURE BANDPASS FILTER

The TSA Series of high-Q subminiature bandpass filters for RF and microwave applications have been introduced by Telonic.

The new filters are only $\frac{1}{4}$ " thick. They are available with 2 to 6 sections, centre frequencies from 100 MHz to 1 CHz, and bandwidths between 2.0% and 20%.

The TSA devices are helical resonator filters of 0.05-db Chebishev design. They combine extremely light weight with a rectangular configuration which is quite unusual in filters of their size and frequency range.



Typical specifications are given for a 4-section TSA filter, with a 248 MHz centre frequency, as follows: Insertion loss is 2.5 db; 3 db bandwidth is 15 MHz, 40 db bandwidth is 45 MHz; dimensions are 2.0" by $9\frac{1}{16}$ " by $\frac{1}{4}$ " (not including connectors); and weight is $14\frac{1}{2}$ grams.

One of the most pronounced packaging advantages of the TSA Series is that input and output connections may be made from any set of faces on the filter. Filter connectors may be of the standard coaxial type, or may be pin or tab connectors for attachment to printed circuit boards.

ENQUIRY 291

STANDBY POWER SUPPLY

Continuous operation of frequency standards and other time-keeping instruments, in case of power line interruptions, is assured by a new Hewlett-Packard standby power supply. Model 5085A automatically assumes the load, without switching, upon any interruption of ac power. The new supply provides higher current than its predecessors, although it occupies no more space. It was especially designed to power Hewlett-Packard's new Model 5060A Cesium Beam Primary Frequency Standards for periods up to 14 hours. Thus it may also be used to maintain full operation of such a standard during transportation, even over long distances.

Up to two amperes of current may be drawn from Model 5085A, at 24 volts. Panel lights indicate normal operation under ac power, battery-charging toward full reserve, or the occurrence of ac power failure; other panel lights indicate

if the power interruption is due to fuse failure. A built-in relay may be used to actuate an external alarm signal, and remotely indicate if operation is ac or battery powered.

Vented nickel-cadmium batteries, derated for added reliability, are under the control of solid-state circuitry in Model 5085A. The Hewlett-Packard Model 5085A Standby Power Supply occupies a rack-convertible cabinet less than seven in. high, weighs 75 pounds.

ENQUIRY 224

MICROMETER WITH DUAL ENGLISH/METRIC READINGS

A British company is producing what is claimed to be the first micrometer with dual English/metric readings. Suitable for countries which manufacture for users of both systems, it eliminates the duplication of measuring devices and makes the use of conversion tables unnecessary in technical drawing and on the shop floor. Measurements can be read to within four ten thousandths of an inch or to one hundredth of a millimetre.

The micrometer, called the Anglometric, has an inner sleeve from which English measurements can be read from a horizontal axis, and metric equivalents off a curved axis. The English scale is marked in tenths of an inch with subdivisions of 0.02 in. and the metric scale marked in five millimetres subdivided in 0.5 millimetres. The thimble is graduated in the usual way. The Anglometric is made in steel throughout with hard chrome plated wearing parts. There is a locking switch for accurate measurement of pre-set dimensions.

ENQUIRY 304

TRANSISTORISED COMMUNICATIONS RECEIVER OPERATES FROM ANY POWER SOURCES

Power requirements of a new British all-transistor high grade communications receiver are so flexible that it can operate from AC mains of 100/125 volts and 200/250 volts at 48-400 c/s, or from a 24 volt DC source. Power consumption on DC is only 18 watts. Modular construction eases servicing and also improves screening, say the manufacturers, and as a result radiation is low.

With a frequency coverage of 60 kc/s to 30.1 Mc/s, the receiver is suitable for continuous wave (CW), amplitude modulated (AM), and single sideband (SSB) use, while an external demodulator is available for frequency shift keying (FSK) or two-tone telegraph reception. A noise factor of 9dB is claimed for the high frequency range. Long term stability is said to be better than 30 c/s over long periods of use, and better than 5 c/s short term. An internal 100 kc/s calibration marker enables a setting accuracy better than 100 c/s to be achieved, the makers say.

A two-speed tuning control covers a 1,000 kc/s range and the receiver is

switched through its operating range in 30 one-megacycle steps. Scale length is 70 in. (178 cm.) per megacycle. According to its manufacturers, the receiver will handle signals of one-volt root mean square (RMS), and will not be damaged by signals as strong as six volts. Image rejection is better than 80 dB and internally generated spurious signals are substantially at noise level over the HF band. A fully automatic gain control system does not need switched aerial attenuators and has a quick attack and decay time which is said to be ideal for SSB control.

An internal loudspeaker is fitted, plus audio outputs for headsets and line connections. The receiver will operate in ambient temperatures of minus 20 degrees Centigrade to plus 55 degrees Centigrade, and can be stored in temperatures from minus 40 degrees Centigrade to plus 70 degrees Centigrade. The receiver complies with the British Crown Agents' specification for worldwide applications.

ENQUIRY 310

RELAYS WITH BUILT IN SIGNAL LAMP

Simple and efficient visual indication of coil energisation is ensured by relays with a built-in signal lamp developed by a British firm. The need for separate signal lamps can often be avoided with a consequent saving in both materials and assembly time. Beneath the top cover of each relay is fitted a miniature neon lamp of high reliability connected in parallel with the coil circuit. When the coil is energised, a clear indication is provided.

In large panels containing many relays for example a glance is sufficient to see which units are energised. A rapid visual check of a circuit condition can be made because the neon indicates the energised state. The equipment is also useful where a warning indicator is necessary. Additionally, to simplify testing and maintenance, relays energised in turn will illuminate if operating correctly.

Two-pole and three-pole relays are available with coils suitable for voltages ranging from 240 a.c. 50 cycles through to 220, 200 and 110. The d.c. range is from 240 through 220, 210, 200, 190, 180, 120, 110.

ENQUIRY 303

ELECTROPHORESIS POWER PACK

A high stability electrophoresis power pack, developed by a British firm for fluid analysis in biochemical research, is said to be the first instrument of its type to have linked current and voltage control circuits — a feature that enables closer refinement of power levels and which is important in detailed analytical work.

The pack automatically adjusts output to account for changes in power load characteristics and provides safety from overload damage without circuit interruption. Thus a new level of reliability in prolonged use is given. A fully transistorised circuit makes the unit much smaller in overall size and there is less heat dissipation and extended component life.

ENQUIRY 302

ENQUIRY CARD AD. 19



COLD LOGIC

When the problem is the lowering of temperature, it's a matter of cold logic to use 'ARCTON' chlorofluorohydrocarbon refrigerants from I.C.I. They're of consistent high quality and low moisture content; and they're non-toxic, non-corrosive and non-inflammable.

You'll find a refrigerant ideally suited to your particular needs in the wide 'ARCTON' range.

If you would like detailed information on 'ARCTON' Refrigerants and their application, write to I.C.I. (N.Z.) Ltd.

'ARCTON'
REFRIGERANTS

N.Z. Stockists:

Electric Refrigeration N.Z. Ltd., 210-214 Lambton Quay, Wellington.
 Ellis Hardie Syminton Ltd., Fanshawe St., Auckland.
 Ellis Hardie Syminton Ltd., Thorndon Quay, Wellington.
 Ellis Hardie Syminton Ltd., P.O. Box 1569, Christchurch.
 Frigidaire Div. of General Motors N.Z. Ltd., P.O. Box 795, Wellington.
 A. W. McDonald Ltd., 5-7 Weld Street, Auckland.
 Allan Newbold & Co. Ltd., Thorndon Quay, Wellington.
 G. E. Patton Ltd., P.O. Box 92, Christchurch.

N. O. Pierson Ltd., 27a Southwark St., Christchurch.
 Refrigeration Engineering Co. Ltd., P.O. Box 12072, Auckland, S.E.4.
 Refrigeration & Heating Engineers Ltd., P.O. Box 976, Dunedin.
 Seal Unit Service Ltd., Holland Street, Wellington.
 H. Simpson Ltd., P.O. Box 583, Christchurch.
 Simpson-Kane Refrigeration Ltd., 86 Vivian Street, Wellington.
 Spicers Home Appliance Centre Ltd., 93 Bridge Street, Nelson.
 and from a New Zealand-wide network of authorised Frigidaire Dealers.

**IMPERIAL CHEMICAL INDUSTRIES (N.Z.) LTD.**

P.O. Box 900
AUCKLAND

P.O. Box 1592
WELLINGTON

P.O. Box 1486
CHRISTCHURCH

GC/2676/64

TELEVISION REPEATER

This television repeater unit at the low price of £25 (plus tax) is proving popular for covering small, remote "pockets". Its manufacturers claim extreme reliability, even under snow and ice conditions, low battery consumption and great compatibility with input and output boosters. The manufacturers also state that a number of these fringe area units have been running continuously for two years and have shown no reduction in power output.

ENQUIRY 307

* * *

LOW COST HI-FI SPEAKER

A high-fidelity cabinet speaker — a completely new departure for an old-established company, has been announced. The model is a high-sensitivity composite unit consisting of a 6½ in. diameter low-resonance "woofer" and a 3½ in. "tweeter" mounted, complete with crossover network, in a sapele veneered cabinet only 14 in. wide x 9 in. high x 8½ in. deep. The new speaker is claimed to offer a far better performance than anything hitherto available within £10 of its price range.

The frequency response is shown to be remarkably level over the entire audio range from 80 c/s to 20 Kc/s, and waveform distortion at low frequencies is virtually negligible. The special suspension design of the low-frequency unit permits linear cone movement at all amplitudes, giving a true bass response uncoloured by resonances, while a "clean" middle and upper frequency response is ensured by the use of a highly absorbent organic fibre

cabinet lining. The unit is suitable for valve or transistor amplifiers with 8-15 ohms output impedance, and will handle 12 watts at programme level. A larger model, with an 8 in. low-resonance speaker, is expected to be marketed later.

Two new monophonic crystal pick-up cartridges are also announced, both of which have outstandingly good bass response. Type TMX10 has an output voltage of 150 mV R.M.S. (minimum) at 1 cm/sec. Frequency response is uniform over the range 20 c/s to 12 Kc/s within ± 5 dB, recommended tracking weight 4-6 grammes. Type TMX20 also has uniform frequency response within the same limits but has an output voltage of 500 mV R.M.S. (minimum) at 1 cm/sec. Recommended tracking weight is 7-9 grammes.

ENQUIRY 306

* * *

VERSATILE TIMERS ARE ECONOMICAL

Versatile and inexpensive timers of the automatically resetting type can be started by remote control. The variety of contact arrangements which can be achieved is very large for a unit so economically priced, say the British makers.

They will operate satisfactorily in any position. The basic design is intended for mounting on a horizontal chassis or panel which will generally be incorporated into a complete control scheme. The units may be mounted either behind or on a vertical or sloping panel by means of a special bracket available as an extra.

Repetitive accuracy of the timer is approximately plus or minus three per cent of full scale setting. A large selection of time ranges are available. The mechanism is built on a nickel-plated sheet steel backplate fitted with a grey plastic cover. The dial is semi-matt silver printed in black.

A setting pointer is fitted enabling the operator to select the delay period required. The pointer does not move during the actual timing period and it must not be altered while the unit is running.

A self-starting synchronous a.c. motor drives the timing mechanism. Where maximum accuracy is demanded, it is recommended that the motor is arranged to start before timing commences and with the exception of two models in the range the circuits shown include this feature.

With the motor running, timing takes place when the electro-magnetic clutch coil is energised. When this occurs an operating lever within the unit travels towards the zero position at which it operates the heavy duty changeover output switch. When the clutch is de-energised, the timer returns to the start position.

Standard units are for operation from 200/250V 50 cycle supplies. Timers can be provided to order for 110V or 400/440V 50 cycles. Units suitable for certain 60 cycles supplies are also available. The heavy duty changeover switch is rated at 5A at 250V a.c. or 2A at 440V a.c.

ENQUIRY 305

CUT HERE

ADVERTISEMENT & PRODUCT ENQUIRY SERVICE

TO OBTAIN MORE INFORMATION ABOUT PRODUCTS OR SERVICES MENTIONED IN THIS ISSUE FILL IN ITS NUMBER, YOUR NAME AND ADDRESS, CUT OUT THE COUPON, AND POST IT.

1st FOLD

If you require your own subscription postage free each month fill in here — we will invoice you.

Please send me

RADIO, ELECTRONICS AND COMMUNICATIONS

for

12 months — 30/-
24 months — 50/-

NAME _____

ADDRESS _____

3rd FOLD

AUTHORITY No.
1231
AUCKLAND, N.Z.

BUSINESS REPLY POST

Postage will be paid by

THE MAGAZINE PRESS LTD.

P.O. BOX 1365

AUCKLAND

2nd FOLD

FIX HERE

FEEDER LINE

This open feeder line is claimed to have as little as one quarter the loss of ordinary 300 OHM flat ribbon when dry and only one eighth in wet conditions. It is not affected by dampness, salt, soot or humidity and maintains consistent 300 OHM impedance match. This low loss open feeder line is available in 100 yd. coils and matching low loss metal thread and woodcrew stand-off insulators are produced by the same manufacturer.

ENQUIRY 308**MARINE RADIO STATION**

This Dansk Radio station is small in size, and is very simple to operate because all knobs and handles used in the daily work are within reach of the operator's chair with adequate working space right in front of the operator.

The lay-out of the station is made in such a way that no special specifications are necessary for the room in which it should be installed. All the design necessary is a suitable corner. If the original lay-out is kept it is possible to use prefabricated cabling. This means a less expensive cabling and a considerable reduction in installation costs.

Main Transmitter: Three small dimension powerful transmitters type S 250 - S 249 E(C) - S 649 giving a power from the output valves of 330 - 750 - 750 W, respectively, at H.F. telegraphy, and 330 - 300 - 550 W, respectively, at H.F. telephony, are available.

All transmitters provide:

Medium frequency telegraphy, 405-535 kc/s, A1 and A2.

Coastal telephony, 1605-3800 kc/s, A3.
High frequency telegraphy, 4-23 Mc/s, A1.

High frequency telephony, 4-23 Mc/s, A3.

Antenna Control Unit Type 42: This unit is designed for switching of main- and emergency antennas to main and reserve/emergency transmitters. The antenna control unit is provided with D.F. interlocking and has a built-in artificial antenna. The panel offers a suitable space for the radio clock and the loudspeaker for the main receiver.

Main Receiver Type M 97 is a high quality and high performance receiver; has built-in crystal calibration facilities. It has provision for up to 10 crystal-controlled spot frequencies. This controls the following 0-100 kc/s on the ranges from 3.6 to 26 Mc/s when using the fine tuning scale.

Frequency ranges: 14-21 kc/s and 100 kc/s - 26 Mc/s in ten bands. Separate logging scale 0-100 kc/s.

Control Panel: This unit contains the microtelephone, telephone exchange controls, switch for receiver antennas and socket for key plug.

Reserve and Emergency Transmitter Type S 106 RT: Has a power from the output valves of 75W. The transmitter has 8 crystal-controlled frequencies in the range 405-535 kc/s. The power supply unit mounted just below the transmitter contains a transistor converter and a charging rectifier. The charging rectifier is so designed that it is capable of supplying the transmitter directly from the ships mains. The power supply unit

also contains the automatic alarm signal keyer AT 7 for keying the transmitter with the international alarm signal.

Keys for main and reserve transmitters are included in the equipment.

Reserve and Emergency Receiver: The M 114 receiver is fully transistorised and uses printed wiring techniques. It is designed for A1, A2 as well as A3 reception in the frequency ranges 195-520 kc/s and 590 kc/s - 26 Mc/s in four bands. The receiver is equipped with a built-in loudspeaker which can be switched off when handset is used.

Auto Alarm A 7N: This apparatus is pretuned to the telegraphic distress frequency 500 kc/s. The auto alarm incorporates automatic noise limiting gain control, it has a built-in watch loudspeaker and a signal strength meter.

Precabbling: In a plastic channel behind the cabinets a complete factory-made cable tree is placed. This is one of the great advantages of the compact radio station because by means of this the time necessary for installing the equipment onboard the ship can be effectively reduced and thereby installation costs cut. Connected to the cable tree is the main switch board containing switches and fuses for the equipment.

Outside the radio station, two more instruments are needed: A direction finder and a lifeboat transmitter. Dansk Radio produce the P179G and the P279G d.f. and the SM118 portable lifeboat radio telegraph telephone transmitter/receiver for this use. Dansk Radio are represented by Coastal Radio (N.Z.) Ltd.

ENQUIRY 313

Radio, Electronics and Communications

[] Please send me, without obligation, information on the item numbers listed below.

[] Please record my subscription as detailed on reverse side.

The FREE Postage does not apply to overseas readers.

Ref. No.	Ref. No.	Ref. No.	FREE READER INFORMATION SERVICE
Ref. No.	Ref. No.	Ref. No.	
Ref. No.	Ref. No.	Ref. No.	
Other			

Your Name Position Held

Name of Firm

Address

Nature of Business

BLOCK CAPITALS PLEASE

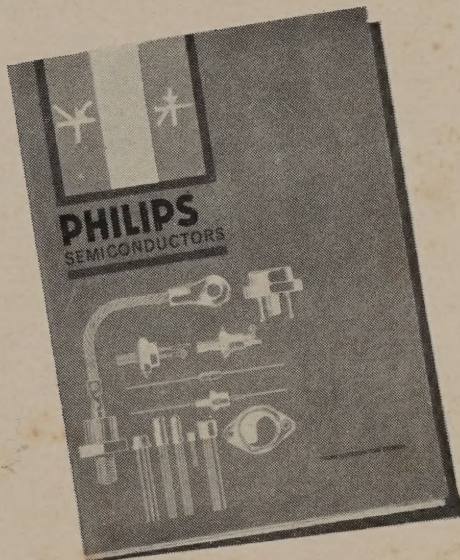
For more information on

- ADVERTISEMENTS
- NEW EQUIPMENT AND MATERIALS
- NEW LITERATURE

fill in the Enquiry Card number of the advertisement or product you are interested in and we will forward it to the company concerned.

MAY, 1966

NOW AVAILABLE- a complete guide



to the use, characteristics and range of **PHILIPS** semiconductors!

A COMPLETE REFERENCE BOOK FOR ONLY 15/-

This reference book of the PHILIPS range of diodes, transistors and rectifiers, gives detailed specifications of their application and characteristics. It offers a quick and handy reference to the technician searching for the right semiconductor to do a specified job. No reference library is complete without it.

FILL IN THIS COUPON OR WRITE TO:

Philips Electrical Industries of New Zealand Limited,
P.O. Box 2097, Wellington.



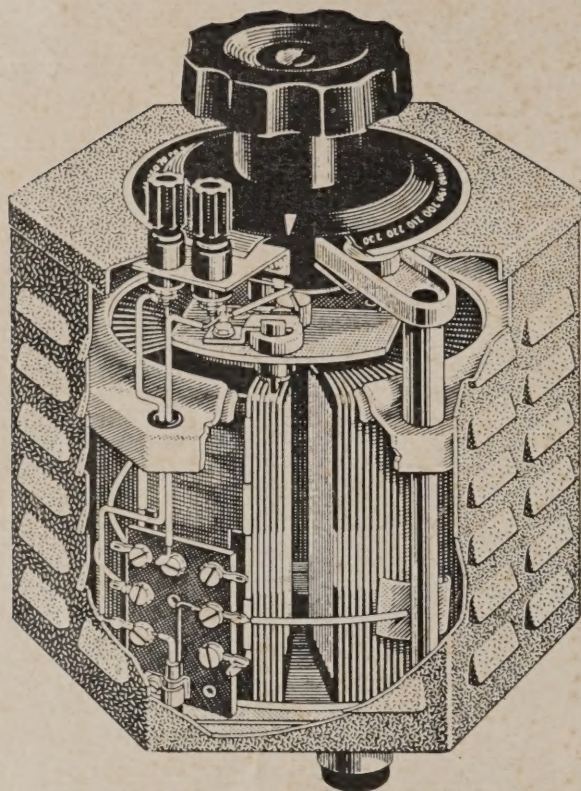
Attached is my cheque/money order for 15/-. Please forward by return mail, a copy of the reference book "Philips Semiconductors".

NAME

Address

ENQUIRY CARD AD. 21

PHILIPS *Variable transformers*



IMPORTANT!

Recently released overseas and an **ESSENTIAL** for all TV service work is the new Philips double-wound **ISOLATING** variable transformer. These transformers have a power rating of 350 watts which is more than sufficient for all TV service work. They are available for bench mounting complete with fusing and voltmeter, or for panel mounting. Further particulars on request. Limited stocks only are available.

Philips variable transformers are designed and manufactured with such care that they will give reliable service over a long period of life. They are available mounted in a durable, attractive case or without the case for panel mounting.

- ★ Can be mechanically coupled for series, parallel or 3-phase (star connected) operation.
- ★ Accurate and uninterrupted regulation.
- ★ Individual units rated up to 2 kVA.
- ★ Low weight, small dimensions.
- ★ Continuously variable from zero to 20% above input voltage.
- ★ Highly efficient due to extremely low "no-load" losses.
- ★ Toroidally wound.
- ★ Low cost.
- ★ Suitable for ganging and combining.
- ★ **All models available ex stock.**

Write or telephone today for further particulars
Illustrated catalogue available.



**ELECTRONIC DEVELOPMENT
AND APPLICATIONS CO. LTD.**

P.O. Box 6415, Telephone 54-039,
WELLINGTON.

P.O. Box 9338, Telephone 545-082,
548-576,
AUCKLAND.